ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS

METALLURGICAL ENGINEERING

For

B.TECH FOUR YEAR DEGREE COURSE

(Applicable for the batches admitted from 2002-2003)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
KUKATPALLY, HYDERABAD - 500 072.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY

HYDERABAD

B. Tech. (Regular) Four Year Degree Course (Revised) Academic Regulations

(Effective for the students studying I year from the Academic Year 2002-2003 and onwards)

1. **Award of B.Tech. Degree:**

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

   i. He has pursued a course of study for not less than four academic years and not more than eight academic years.

   ii. He has registered for and studied all the subjects for a total of 212 credits and secured all the 212 credits.

2. 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 the course and their seat shall stand cancelled.

3. **Courses of study:**

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

   1. Aeronautical Engineering
   2. Bio-Medical Engineering
   3. Bio-Technology
   4. Chemical Engineering
   5. Civil Engineering
   6. Computer Science and Engineering
   7. Computer Science and Systems Engineering

8. Electrical and Electronics Engineering
9. Electronics and Communication Engineering
10. Electronics and Computer Engineering
11. Electronics and Control Engineering
12. Electronics and Instrumentation Engineering
13. Electronics and Telematics Engineering
14. Information Technology
15. Instrumentation and Control Engineering
16. Mechanical (Mechatronics) Engineering
17. Mechanical (Production) Engineering
18. Mechanical Engineering
19. Metallurgical Engineering
20. Metallurgy and Material Technology

and any other course as approved by the authorities of the University from time to time.

4. Credits:

	Semester Pattern		Yearly Pattern	
	Periods / Week	Credits	Periods/Week	Credits
Theory	04	04	03	06
Practicals	03	02	03	04
Practicals	06	04	06	08
Project	08	08	—	—

5. Distribution and Weightage of Marks:

i. The performance of a student in each semester / I year shall be evaluated subject –wise with a maximum of 100 marks for theory and 75 marks for practical subject. In addition, project shall be evaluated for 200 marks.

ii. For theory subjects the distribution shall be 20 marks for Internal Evaluation and 80 marks for the End-Examination.

iii. For theory subjects, there shall be 5 objective type tests for a duration of 20 minutes each during the semester. Each test shall contain 20 objective type questions for 20 marks. The best 4 tests will be considered for awarding 20 sessionals marks. For the I year class which shall be on yearly basis, there shall be 6 tests of the same duration and weightage as mentioned above. However, the performance in the best 4 tests will be considered for awarding 20 sessional marks.

iv. For practical subjects there shall be a continuous evaluation during the semester for 25 sessional marks and 50 End Examination marks. Of the 25 marks for internal, 15 marks shall be awarded for day-to-day work and 10 marks to be awarded by conducting Internal Lab Test(s). The End Examination shall be conducted by the teacher concerned and another member of the staff of the same institution.

v. For the subject having design and / or drawing, and estimation, the distribution shall be 20 marks for internal evaluation (10 marks for day-to-day work and 10 marks for internal tests). There shall be two internal tests in a Semester and the better of the two will be taken into consideration. However in the I year class, there shall be three tests and the best two will be taken into consideration for a maximum of 20 marks. The End Examination shall be for a total of 80 marks.

vi. The Engineering Drawing Practice Course wherever offered is to be treated as a practical course. Evaluation method adopted for practicals shall be followed here also.

vii. Out of a total of 200 marks for the project work, 40 marks shall be for Internal Evaluation and 160 marks for the End Semester Examination. The End Semester Examination (viva-voce) shall be conducted by a board of examiners consisting of Guide, Head of the Department and an external examiner. The evaluation of project work shall be conducted at the end of the IV year. The Internal Evaluation shall be on the basis of two seminars given by each student on the topic of his project.

viii. Laboratory marks and the sessional marks awarded by the College are not final. They are subject to scrutiny and scaling by the University wherever felt desirable. The uniform distribution of awarding of Sessional marks and Laboratory marks will be referred to a Committee. The Committee will arrive at a scaling factor and the marks will be scaled as per the scaling factor. The recommendations of the Committee are final and binding. The laboratory records and internal test papers shall be preserved in the respective departments as per the University norms and shall be produced to the Committees of the University as and when they visit the College.

6. **Attendance:**

i. A student has to put in a minimum of 75% of attendance in aggregate of all the subjects for acquiring credits in the I year and / or each semester thereafter.

ii. Shortage of attendance in aggregate upto 10% (65% and above and below 75%) in each Semester or I year to be condoned by the Vice-Chancellor on the recommendations of the Sub-Committee of the Academic Senate on valid and genuine grounds.

iii. A student will not be promoted to the next semester unless he satisfies the attendance requirement of the present semester / I year.

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 / I year are not eligible to take their end examination of that class and their registration shall stand cancelled. They may seek re-admission for that semester / I year when offered next.

vi. Condonation of shortage of attendance as stipulated in 6 (ii) above shall be granted on genuine and valid grounds with supporting evidence.

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

7. **Minimum Academic Requirements:**

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

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% 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 successfully complete all the I year subjects from 3 regular consecutive examinations and 3 supplementary consecutive examinations of I year from the date of admission. If he has failed to do so he shall forfeit the seat in course and his seat shall stand cancelled.**

iii. A student shall be promoted from II to III year only if he fulfils the academic requirement of 56 credits from one regular and one supplementary examinations of I year, and one regular and one supplementary examinations of II year I semester, and one regular examination of II year II semester irrespective of whether the candidate takes the examination or not.

iv. A student shall be promoted from third year to fourth year only if he passes all the subjects of I year and fulfils the academic requirements of total 100 credits (including 56 credits of I year) from the examinations,

a. Two regular and two supplementary examinations of I year.

b. Two regular and two supplementary examinations of II year I semester.

c. Two regular and one supplementary examinations of II year II semester.

d. One regular and one supplementary examinations of III year I semester.

e. One regular III year II semester examination.

v. **A student shall earn all the 212 credits offered as indicated in the course structure.**

vi. **Students who fail to earn all the 212 credits offered as indicated**

in the course structure within eight academic years from the year of their admission shall forfeit their seat in the course and their seat shall stand cancelled.

8. Withholding of Results:

The result of a student shall be withheld if:

i. He has not cleared any dues to the Institution / Hostel;

ii. A case of disciplinary action against him is pending disposal;

9. Course pattern:

i. The entire course of study is of four academic years. The first year shall be on yearly pattern and the second, third and fourth years on semester pattern.

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

10. Award of Class :

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

First Class with Distinction	70% and above	From the aggregate marks secured for 212 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%	

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

11. Minimum Instruction Days :

The minimum instruction for each semester / I year shall be 90/180 working days excluding examination days.

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

13. There shall be no place transfer within the Constituent Colleges of Jawaharlal Nehru Technological University for B.Tech. Regular / FDH / CCC and P. G. Programmes.

General:

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

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

16. In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.

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

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
HYDERABAD
Academic Regulations for B. Tech. (Lateral Entry Scheme)

(Effective for the students getting admitted into II year from the Academic Year 2003-2004 and onwards)

1. The Students have to acquire 156 credits from II to IV year of B.Tech. Programme (Regular) for the award of the degree.
2. Students, who fail to fulfill the requirement for the award of the degree in 6 consecutive academic years from the year of admission, shall forfeit their seat.
3. The same attendance regulations are to be adopted as that of B. Tech. (Regular).
4. Promotion Rule:

   A student shall be promoted from third year to fourth year only if he fulfils the academic requirements of 44 credits from the examinations.

   a. *Two regular and two supplementary examinations of II year I semester.*
   b. *Two regular and one supplementary examinations of II year II semester.*
   c. *One regular and one supplementary examinations of III year I semester.*
   d. *One regular III year II semester examination.*
5. Award of Class :

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

First Class with Distinction	70% and above	From the aggregate marks secured for 156 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%	

   (The marks in internal evaluation and end examination shall be shown separately in the marks memorandum)
6. All other regulations as applicable for B. Tech. Four-year degree course (Regular) will hold good for B. Tech. (LES)

METALLURGICAL ENGINEERING

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD

COURSE STRUCTURE – METALLURGICAL ENGINEERING

(Applicable for the Academic Year 2002-2003)

I-B.Tech. (MET):

Subject	Th	Pr	C
English	3	0	6
Mathematics – I	3	0	6
Engg. Physics Theory (Common with Mech. Engg.)	2	0	4
Engg. Physics Lab (Common with Mech. Engg.)	0	3/2	2
Metallurgical Analysis	3	0	4
Metallurgical Analysis Laboratory	0	3/2	2
Engineering Graphics	0	6	8
Workshop Practice	0	3	4
Introduction to Computers	3	0	6
Computers Lab	0	6	8
Engineering Mechanics	3	0	6
TOTAL	17	18	56

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METALLURGICAL ENGINEERING

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD

COURSE STRUCTURE – METALLURGICAL ENGINEERING

(Applicable for the Academic Year 2002-2003)

II-B.Tech. (MET) – I Semester:

Subject	Th	Pr	C
Mathematics – II	4	0	4
Electrical Engineering	4	0	4
Mechanics of Solids	4	0	4
Data Structures through 'C'	4	0	4
Physical Metallurgy	4	0	4
Furnace Technology and Pyrometry	4	0	4
Data Structures through 'C' Lab	0	3	2
Physical Metallurgy Lab	0	3	2
TOTAL	24	6	28

II-B.Tech. (MET) –II Semester:

Subject	Th	Pr	C
Mathematics – III	4	0	4
Mechanics of fluids	4	0	4
Basic Electronics	4	0	4
Fuels Technology and Refractories	4	0	4
Thermodynamics and Kinetics	4	0	4
Mineral Dressing	4	0	4
Fuels Technology and Refractories Lab	0	3	2
Mineral Dressing Lab	0	3	2
TOTAL	24	6	28

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METALLURGICAL ENGINEERING

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD

COURSE STRUCTURE – METALLURGICAL ENGINEERING

(Applicable for the Academic Year 2002-2003)

III-B.Tech. (MET) – I Semester:

Subject	Th	Pr	C
Probability and Statistics	4	0	4
Managerial Economics and Financial Analysis	4	0	4
Principles of Extractive Metallurgy	4	0	4
Heat Treatment Technology	4	0	4
Metallurgical Thermo Dynamics	4	0	4
Techniques of Metal Joining	4	0	4
Principles of Extractive Metallurgy Lab	0	3	2
Heat Treatment Technology Lab	0	3	2
TOTAL	24	6	28

III-B.Tech. (MET) – II Semester:

Subject	Th	Pr	C
Management Science	4	0	4
N. F. Ext. Metallurgy	4	0	4
Mechanical Metallurgy	4	0	4
Foundry Technology	4	0	4
Iron Production	4	0	4
X-Ray Metallography	4	0	4
Mechanical Metallurgy Lab	0	3	2
Foundry Technology Lab	0	3	2
TOTAL	24	6	28

METALLURGICAL ENGINEERING

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD

COURSE STRUCTURE – METALLURGICAL ENGINEERING

(Applicable for the Academic Year 2002-2003)

IV-B.Tech. (MET) – I Semester:

Subject	Th	Pr	C
Electro Metallurgy & Corrosion	4	0	4
Steel Making	4	0	4
Mechanical Working of Metals	4	0	4
Elective – I	4	0	4
Elective – II	4	0	4
Powder Metallurgy	4	0	4
Electro Metallurgy & Corrosion Lab	0	3	2
Mechanical Working of Metals Lab	0	3	2
TOTAL	24	6	28

Elective - I:

1. Semi-conductors & Magnetic Materials
2. NDT Methods
3. Ceramics and Composite Materials
4. Computer Graphics & Multimedia Systems.

Elective – II:

1. CAD / CAM
2. Super Alloys
3. Metallurgical Instrumentation
4. Nuclear Metallurgy

IV-B.Tech. (MMT) – II Semester:

Subject	Th	Pr	C
Elective –III	4	0	4
Elective –IV	4	0	4
Project	8	0	8
TOTAL	16	0	16

Elective – III:

1. Environmental Engineering

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2. Metallurgical Problems
3. Light Metals and Alloys
4. Simulation and Data Processing

Elective-IV:

1. Alternate Energy Sources
2. Transport Phenomena in Metallurgy.
3. Ferro Alloy Technology
4. Experimental Techniques in Metallography.
5. Operations Research.

METALLURGICAL ENGINEERING

I-B.Tech. **Credits – 6**
3 Periods/week Max. Marks – 80

The following textbooks of English are prescribed for I-B.Tech. Class of all branches in the Colleges of Engineering and Technology affiliated to Jawaharlal Nehru Technological University, Hyderabad. The exercises given are expected to be covered by the teacher in the classroom, the objective of the course being development of linguistic skills of the learners.

1. A Textbook of English for Engineers and Technologies, O.L
2. Masterminds, O.L.

ENGLISH
(Common for all branches)

UNIT – I

1. Energy, Unit 3: Alternative Sources (from A Text Book of English for Engineers and Technologists (O.L).
2. Jagadish Chandra Bose, (a Profile from The Trailblazers in Masterminds, O.L.)

UNIT II:

1. Computers, Unit 2: New Frontiers(from A Text Book of English for Engineers and Technologists, O.L)
2. Chandrasekhara Venkata Raman, (a Profile from The Trailblazers in Masterminds, O.L.)

UNIT – III:

1. Technology , Unit 3: Evaluating Technology (from A Text Book of English for Engineers and Technologists, O.L)
2. S. S. Bhatnagar, (a Profile from The Institution Builders in Masterminds, O.L.)

UNIT – IV:

1. Environment, Unit 1: Pollution,(from A Text Book of English for Engineers and Technologists, O.L)
2. Homi Jehangir Bhabha, (a Profile from The New Age in Masterminds, O.L.)

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UNIT -V:

1. Industry, Unit 2: Safety and Training, (from A Text Book of English for Engineers and Technologists, O.L)
2. Salim Ali, (a Profile from The Living World in Masterminds, O.L.)

UNIT- VI:
Common errors
Sentence completion
Synonyms and Antonyms
Analogy
Report Writing
Comprehension
General Essay
Situational Dialogues

NOTE:
The establishment of an English language laboratory in each affiliated college of Engineering and Technology is recommended from the academic year 2002-2003 for the following reasons.

1. to expose the students to TOEFL and GRE model of training and practice.
2. to help the students learn correct pronunciation, accent and intonation.
3. to enable the students to improve and strengthen their communicative skills
4. to expose the students to different variations in English expression

It is also recommended that the English Language Laboratory training and practice be treated as a Non-examination item of the Curriculum.

BOOKS RECOMMENDED:

1. Strengthen your Writing by V.R. Narayana Swami (O.L)
2. Success with Grammar and Composition by K.R. Narayana Swamy (O.L)
3. Examine Your English by Margaret M. Maison (O.L)
4. English for Professional students by S.S. Prabhakara Rao
5. TOEFL (AARCO & BARRONS, USA)
6. GRE (AARCO & BARRONS, USA)
7. Communication Skills for Technical Students, by T. M. Farhathullah (O.L)

METALLURGICAL ENGINEERING

I- B.Tech. **Credits – 4**
3 Periods/week Max. Marks – 80

MATHEMATICS - I

6 Credits (Common to all Branches)

Effective for the batches admitted in the year 2002 and onwards.

UNIT – I

Sequences – Series – Convergence and divergence – Ratio test-Comparison test – Integral test – Cauchy's root test – Raabe's test – Absolute and conditional convergence.

Rolle's theorem – Lagrange's Mean Value theorem – Cauchy's Mean value Theorem – Generalized Mean Value theorem (Taylor's Theorem)

UNIT – II :

Functions of several variables – limit and continuity – partial differentiation – Chain rule – Total derivative – Euler's theorem, Jacobian – Functional dependence. Maxima and Minima of functions of two variables with and without constraints, Radius, Centre and Circle of Curvature – Evolutes and Envelopes.

UNIT – III

Curve tracing – Cartesian, polar and Parametric curves. Applications of integration to lengths, volumes and surface areas in Cartesian and Polar coordinates.

UNIT – IV

Differential equations of first order and first degree – formation. Exact, linear and Bernoulli.

Applications to Newton's Law of cooling, Law of natural growth and decay, Orthogonal trajectories, Non-homogeneous linear differential equations of second and higher order with constant coefficients with RHS term of the type e^{ax}, sinax, cosax, polynomial in x, e^{ax} V(x),xV(x). method of variation of parameters.

UNIT – V :

Laplace transform of standard functions – Inverse transform – Linearity – first shifting

Theorem. Transforms of derivatives and integrals – Unit step function – second shifting theorem – Dirac's delta function – Differentiation and integration of transforms –

Multiple integrals : Double and tripe integrals – change of variables – Change of order of integration.

METALLURGICAL ENGINEERING

UNIT – VI :

Vector Differential Calculus :

Gradient,. Divergence, Curl and their related properties of sums, Products, Laplacian and second order operators.

Vector integral Calculus : Vector integration – Line integral – work done – Potential function – area, surface and volume integrals. Green's theorem, Stoke's and Gauss'Divergence Therem. Verification of Green's, Stoke's and Gauss' Theorem. Curvilinear Coordinates – Cylindrical, Spherical Coordinates – Expressions of Grad, div, curl in Spherical, Cylindrical and Curvilinear Coordinates.

TEXT BOOKS :

1. A Text Book of Engineering Mathematics Volume – I
   T.K.V. Iyengar, B.Krishna Gandhi, and others S. Chand and Company
2. Engineering Mathematics
   B.V.Ramana, Tata McGraw_Hill 2002 (In press)
3. Engineering Mathematics – I
   C. Sanakraiah, Vijaya Publications (In press)
4. Engineering Mathematics – I
   P. Nageswara Rao, Y. Narsimhulu, Prabhakara Rao ((In press)

SUGGESTED REFERENCES :

1. Engineering Mathematics
   S.K.V.S.Sri Rama Chary, M.Bhujanga Rao, Shankar, B.S. Publications 2000
2. Advanced Engineering Mathematics (Eighth edition)
   Erwin Kreyszig John Wiley & Sons (ASIA) Pte Ltd.
3. Advanced Engineering Mathematics (Second edition)
   Michael D. Green Berg , Prentice Hall
4. Sarveswara Rao Koneru
   Engineering Mathematics Orient Longman Pvt. Ltd. 2002 (Inpress)
5. Engineering Mathematics – I
   N.P. Bali, Laxmi Publications (P) Ltd., New Delhi

METALLURGICAL ENGINEERING

I- B.Tech. **Credits – 4**
2 Periods/week Max. Marks – 80

ENGINEERING PHYSICS
(Common with Mechanical Engg)

UNIT- I: a) Interference of light: Introduction –Superposition of waves-Young's double slit experiment-coherence-types of interference-Interference in thin films-color of thin films-Newton's rings.
b) Diffraction of light: Introduction-Fraunhoffer diffraction at a single slit-Fraunhoffer diffraction due to parallel slits-Fraunhoffer diffraction due to n-parallel slits-diffraction-a qualitative description –diffraction grating-grating spectrum-Fraunhoffer diffraction at a circular aperture-Rayleigh's criteria for resolving power-electron microscope.

UNIT- II: a) Polarisation of light: Introduction-Representation of polarised and unpolarised light-production of polarised light-circular and elliptical polarisation-calculation of phase difference when a linearly polarised light passing through a double refracting crystal.
b) Non Destructive Testing: Introduction –Theory and practice of ultrasonic testing-ultrasonic testing systems-ultrasonic testing methods-application of ultrasonics.

UNIT- III: a) Laser: Introduction: characteristics of laser light-Basic concepts of laser-types of lasers-Ruby laser, He-Ne laser, applications of lasers.
b) Fiber optics: Introduction-basic principles –light wave communication-using optical fibres-numerical aperture – acceptance angle- fibre optics in medicine and industry.

UNIT- IV: a) Thermal properties: Specific heat of solids-Einstein model-photons-thermal conductivity –thermal expansion –thermo electric effect-thermo analysers-thermo gravimetry-thermo mechnical analysis.
b) Dielectric materials: Introduction-Dielectric constant –relative permitivity-loss tangent or dielectric loss-polarisation -dielectric strength-classification of dielectrics-porcelain-glass.

UNIT- V: a) Magnetic materials: Introduction-magnetic moment of electrons and atoms-basic definitions-classification of magnetic materials-diamagnetic materials-paramagnetic materials –ferro magnetic materials –anti ferro magnetic materials, ferri magnetic materials-soft and hard magnetic materials.
b) Superconductivity: Introduction: properties of super conductors-BCS theory of superconductivity-Applications of superconductors.

UNIT- VI: a) Deformation and creep in materials: plastic deformation- plastic strain curve-deformation by slip-strength of crystals-dislocations- multiplication of dislocations mechanism of creep-creep resistant materials.
b) Materials for space application: Space program-structural materials and properties-high temperature materials-materials for thermal protection.

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Text books:
1. Physics for Engineers- M. R. Srivastava (New Age International, New Delhi)
2.A first course in Material science- Raghavan (PHI-New Delhi)

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METALLURGICAL ENGINEERING

I- B.Tech. Credits –2
3/2 Periods/week Max. Marks – 60

ENGINEERING PHYSICS LAB
(COMMON WITH MECHANICAL ENGG.)

Any TEN of the following experiments are to be performed during the academic year.

1. Determination of Rigidity Modulus of the material of a wire (Torsional Pendulum).
2. Study of the normal modes in a string using forced vibrations in rods (Melde's experiment).
3. Study of Resonance – Using audio generator.
4. Coupled Oscillator.
5. Diffraction grating.
6. Dispersion of Light – (Prism – Spectrometer method).
7. Determination of thickness of a thin object by optical method – Parallel fringes.
8. Newton's Rings.
9. Lasers – Single slit and double slit experiments.
10. Study of electrical resonance – LCR circuit.
11. Time constant of an R-C circuit.
12. Sonometer – Verification of laws of stretched strings.
13. Frequency of A.C. Supply.
14. Magnetic field along the axis of a current carrying coil – Stewart and Gee's Method.
15. Optical Fibres – Numerical aperture measurement.
16. Optical Fibres – Study of losses.

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METALLURGICAL ENGINEERING

I- B.Tech. Credits – 4
3 Periods/week Max. Marks – 80

METALLURGICAL ANALYSIS

Unit – I: Importance – Scope and methods of sampling of solids, liquid and gaseous materials with special references to sampling of ores, fuels, flue gases, metals and alloys, industrial and laboratory techniques.

Unit – II: Chemical Analysis – Basic Principles – theory of indicators – qualitative analysis of simple and interfering radicals with special reference to analysis of ores, fluxes, slags, metals and alloys.

Unit – III: Qualitative analysis of common non-ferrous alloys such as brasses, bronzes and solders. Estimation of C, S, Si, Mn, and P in Cast Iron and Steel.

Unit – IV: Estimation of Cr, Ni, Mo, W and V in alloy steels, Determination of iron in iron ore, manganese in manganese ores, lime in limestone, Fire-assay of precious metals.

Unit – V: Instrumental analysis: Importance of instrumental analysis – Comparison with standard wet chemical methods – Fundamental Physicochemical principles involved and equipment required in Colorimetry.

Unit – VI: Absorptiometry, Spectroscopy, potentiometry, amperometric titration, calorimetric titrations, polarography, conductometry, electro-analysis and flame photometry.

BOOK RECOMMENDED:

1. Agarwal, B.C. and Jain S.P: A Text Book of Metallurgical Analysis, Khanna Publishers, Delhi – 1963.
2. Iyer V.G., Metallurgical Analysis: BHU Press, Varanasi.
3. Snell Foster D and Frank M Biffen : Commercial methods of analysis / Che. Publishing Co., 1964.
4. Vogel AI., A Text Book of Quantitative Inorganic Analysis Longman ELBS 1962.
5. Willard H.H.et al: Instrumental Methods of analysis Van Nostrand.

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METALLURGICAL ENGINEERING

I- B.Tech. **Credits – 2**
3/2 Periods/week Max. Marks –

METALLURGICAL ANALYSIS LAB

1. Estimation of Iron in Iron ore. – to determine the percentage of Iron in Iron Ore by $KMnO_4$ method and $K_2Cr_2O_7$ method.
2. Estimation of Silicon in Cast Iron.
3. Estimation of Carbon in Steel by Strohlein apparatus method.
4. Estimation of Copper in Brass by Electrolytic method.
5. Estimation of manganese in cast iron.
6. Estimation of Chromium in Steel.
7. Estimation of Sodium and Potassium in Chloride Salts by Flame Photometry.
8. Estimation of lime in Limestone.
9. Estimation of the concentration of $KMnO_4$ in the solution using Digital Spectrophotometer.
10. Estimation of Sulphur and Phosphorus in cast irons.
11. Estimation of Chromium in Stainless steels.
12. Estimation of Mn, Cr and Si in Ferro-Alloys.

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METALLURGICAL ENGINEERING

I- B.Tech. **Credits – 8**
6 Periods/week Max. Marks – 80

ENGINEERING GRAPHICS

UNIT-I : Introduction to Engineering Drawing:

Principles of Engineering Graphics and their significance, Engineering Drawing-Drawing Instruments and their use –Conventions in Drawing –Lettering –BIS conventions.
Scales used in Engineering practice and Representative Fraction, the principles –Construction of Plain, Diagonal and vernier scales.

Plane Geometric Drawing:
Construction of polygons-Inscription and superscription of polygon given the diameter of the circles.

Curves used in Engineering Practice and their constructions
a) Conic sections including the rectangular Hyperbola-General method only.
b) Cycloid ,Epicycloid and Hypercycloid-Trochaids
c) Involute.

UNIT-II

Drawing of projections or views
Orthographic Projection in First angle projection only:
Principles of Orthographic Projections-Conventions-Projections of Points and lines
Projections of plane regular geometric figures.

UNIT-III:
Projections of Regular solids-Auxillary views.
Sections or Sectional views of Right Regular solids-Prism, Cylinder, Pyramid, Cone, Auxillary views-Sections of sphere.

UNIT-IV:
Development of surfaces of Right Regular Solids- Prism, Cylinder, Pyramid and Cone.
Interpretation of Right Regular Solids-Intersection of Cylinder Vs Cylinder, Cylinder Vs Prism, Cylinder Vs Cone.

UNIT-V:
ISOMETRIC PROJECTION:
Principles of Isometric Projection-Isometric Scale-Isometric Views-Conventions-Isometric Views of Lines, Plane figures, Simple and Compound Solids-Isometric Projection of Spherical parts.

TRANSFORMATION OF PROJECTIONS:
Conversion of Isometric views to orthographic views and Vice-versa-Conventions.

METALLURGICAL ENGINEERING

UNIT-VI:
PERSPECTIVE PROJECTION:
Perspective View: Points, Lines, Plane figures and simple solids (General method only)

TEXT BOOKS: ENGINEERING DRAWING: N.D.BHATT, NARAYANA AND KANNAIH, VENUGOPAL.

METALLURGICAL ENGINEERING

I- B.Tech. **Credits – 2**
3 Periods/week Max. Marks – 60

WORKSHOP PRACTICE

Machine Shop

1. Study of different tools and equipment used in general workshop.
2. Turning of a cylindrical rod.
3. Step turning of a cylindrical rod.
4. Drilling of different dimensions.
5. Milling Exercises.
6. Demonstration on planning and Shaping machines for simple exercises.
7. Gear Cutting (demonstration only).

Arc Welding

1. Different types of joints – lap joint and butt joint
2. Straight polarity and reverse polarity exercises.
3. Horizontal and vertical welding exercises.
4. Demonstration of gas welding.

Smithy and Forging

1. Forging a circular rod into a square rod.
2. Forging a hook shaped component from a circular rod.
3. Upsetting operation.

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METALLURGICAL ENGINEERING

I- B.Tech. Credits – 6
3 Periods/week Max. Marks – 80

INTRODUCTION TO COMPUTERS

(Common to Mech., Civil, Met, MMT, PT., Mechatronics and Mech. Prod.)

Unit I: (Computer Awareness – Qualitative Treatment Only)
Computers, capabilities, types of computers, application areas, computer anatomy, functional block diagram central processing unit, functions of ALU and Control unit in CPU purpose of Registers in CPU, micro-processors CIRC / RISC processors, memory functions, address, word, RAM, ROM, Cache memory, associate memory, magnetic disk, tape, floppy, optical disk, address bus, data bus, control bus, functions of I-O devices, key board, mouse, light pen, dot-matrix printer, line printer, laser printer, ink jet printer, CRT monitor, Colour monitor, CGA, Screen resolution, Flat panel display unit, machine language instruction, stored program concept, assembly language, assembler, high level language, compiler, Operating System, Types of operating systems, Number Systems, Binary, Hex, Octal, BCD Code, Character Codes, 3 methods of binary representation, of integers, floating point numbers.

Unit – II: Computer Programming I:
Algorithm, flow chart program development steps, Basic Structures of C language, C tokens, Data types, declaration of variables, assigning values, arithmetic, relational and logical operators, increment and decrement operators, control operator, bit-wise operators, expressions, evaluation, input – output operations, IF and SWITCH statements, WHILE, DO-WHILE, and FOR Statements, C programs covering all the above aspects.

Unit – III: Computer Programming II:
String Variables in C, declaration, reading, writing, string handling functions, user – defined functions, variables and storage classes, structures, unions, pointers, file management in C, opening, closing and I-O operations on files, C programs covering the above aspects.

Unit – IV: Numerical Methods – I:
Iterative methods, bisection, false position, Newton-Raphson, Successive approximation methods, algorithms, comparison of iterative methods, solution of linear simultaneous algebraic equations, Gauss Jordan and Gauss Siedel 's methods, algorithms.

Unit V: Numerical Methods – II:
Interpolation, Language interpretation, forward difference, Backward difference and central difference interpolation methods, algorithms, errors in interpolation, least square approximation of functions, linear regression, polynomial regression, algorithms.

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METALLURGICAL ENGINEERING

Unit – VI: Numerical Methods – III:
Numerical integration by Trapezoidal and Simpson's rules, algorithms, Numerical solution of differential equations, Euler Method, Runge-Kutta fourth order method, Milne predictor corrector method, algorithms, comparison of Runge-Kutta and predictor – corrector methods.

Books:

1. "Computers and Commonsense" Shelly and Hunt, 4th Edn., PHI.
2. "Programming in ANSI C" E Balaguruswamy.
3. "Computer Oriented Numerical Methods" V Rajaraman.

METALLURGICAL ENGINEERING

I- B.Tech. Credits – 8
6 Periods/week Max. Marks – 60

COMPUTER LAB

1. Write a C program that evaluates the following algebraic expressions after reading necessary values from the user :

a) $(ax + b) / (ax - b)$

b) $2.5\log x + \cos 32^0 + |x^2 - y^2| + \sqrt{2xy}$

c) $x^5 + 10x^4 + 8x^3 + 4x + 2$

d) $(4x + 3)(3y + 2z - 4)$

e) $a e^{-kt}$

f) $(1/\alpha\sqrt{2\Pi})e^{-(x-m/\sqrt{2}\sigma)2}$

2. Write a C program that prints the given 3 integers in ascending order using if – else

3. Using WHILE Statement write a C program to find the sum of 1 + 2+3 + 4 + ...n

4. Repeat problem (3) using do while statement

5. Write C program using FOR statement to find the following from a given set of 20 integers

i. Total number of even integers ii. Total number of odd integers

iii. Sum of all even integers iv. Sum of all odd integers

6. Write a C program to evaluate the following series. Assume suitable value for x

$y= 1 + x^2/2! + x^4/4! + x^6/6! +$ ..... upto 10 terms

7. Write a C program to obtain the product of two matrices A of size (3X3) and B of size (3X2) The result matrix C is t be printed out along with A and B. Assume suitable values for A & B

8. Using switch – case statement, write a C program that takes two operands and one operator from the user performs the operation and then the answer.(Consider operators +, -,/,* and %)

9. Write in C function to evaluate Sinx using the series
$\text{Sin}x = x - x^3/3! + x^5/5! -$ ..... Upto 7^{th} digit accuracy

Also write the main program that uses this function

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METALLURGICAL ENGINEERING

10. Write C procedures to add , subtract ,multiply and divide two complex numbers (x + iy) and (a + ib) . Also write the main program that uses these procedures

11. The total distance traveled by vehicle in t seconds is given by distance = $ut + \frac{1}{2} at^2$ where U and a are the initial velocity (m/sec) and acccelération (m/sec^2). Write C program to find the distance traveled at regular intervals of time given the values of u and a. The program should provide the flexibility to the user to select his own time intervals and repeat the calculations for different values of u and a.

12. Write C program that will read the value of X and evaluate the following function.
Y= 1 for X>0, Y=0 for X=0 , Y=-1 for x<0
Using (i) if statements, (ii) else if statements, and (iii) conditional operator

13. A cloth show room has announced the following seasonal discounts on purchase of items.

Purchase amount	Discount (Percentage)	
	Mill Cloth	Handloom Items
1 –100	-	5.0
101 – 200	5.0	7.5
201 – 300	7.5	10.0
Above 300	10.0	15.0

Write C program using Switch and if statements to complete the net amount to be paid by a customer

14. Given a number , write c program using while loop to reverse the digits of the number , Example 1234 to be written as 4321.

15. The Fibonacci sequence of numbers is 1, 1, 2, 3, 5, 8, ... based on the recurrence relation $F(n) = f(n-1) + f(n-2)$ for $n>2$.
Write C program using do – while to calculate and print the first m fibonacci numbers

16. Write C program to print the following outputs using for loop

1)
```
1
2  2
3  3  3
4  4  4  4
5  5  5  5  5
```

2)
```
                1
             2     2
          3     3     3
       4     4     4     4
    5     5     5     5     5
```

METALLURGICAL ENGINEERING

17. Write a C program to find the product of two matrices.
18. Write a C program to extract a portion of a character string and print the extracted string . Assume that m characters are extracted starting with the n^{th} character.

19. A maruthi Car dealer maintains a record of sales of various vehicles in the following form :

Vehicle type	Month of Sales	Price(Rs.)
Maruthi – 800	02/87	75,000
Maruthi – DX	07/87	95,000
Gypsy	04/88	1,10,000
Maruthi Van	08/88	85,000

Write a C program to read this data into a table of strings and output the details of a particular vehicle sold during a specified period. The program should request the user to input the vehicle type and the period (Starting month & ending month)

20. Write a function that will scan a character string passed as an argument and convert all lower case characters into their upper case equivalents .

21. Write a C program to implement false position method and find one smallest root of the following equation to 3 significant digits

22. Write a C program to find the root of the equation $x^3 - 4x + 1 = 0$ to 3 significant digits using Newton – Raphson method.

23. Write a C program to implement the Newton Gregory forward difference interpolation formula. $f(x) = x \sin x + \cos x = 0$.

24. Write a C program to implement linear regression.

25. Write a C program to implement Gauss – Jordan method

26. Write a C program to implement Gauss – Seidal method.

27. Write a C program to evaluate the integral

$$S=\int_0^5 e^{-x^2} dx$$

using trapezoidal rule with 20 points.

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28. Write a C program evaluate the integral

$$S=\int_0^1 x^3 e^{x-1} dx$$

using Simpson's rule with 10 points.

29. Write a C program to solve the following differential equation using Runga – Kutta fourth Order method.

$dy/dx = x^2 + y^2$, $y(0)=1$, Solution required for $1 > x > 0$.

30. Write a C program to implement the Milne Predictor – Corrector formula

METALLURGICAL ENGINEERING

I- B.Tech. **Credits – 6**
3 Periods/week Max. Marks – 80

ENGINEERING MECHANICS

UNIT-I
Introduction to Engg.Mechanics-Basic Concepts.
Systems of Forces: Coplanar Concurrent Forces-Components in Space –Resultant-Moment of Force and its application –Couples and resultant of Force Systems .
Equilibrium of Systems of Forces:
Free Body Diagrams, Equations of equilibrium of Coplanar Systems and Spatial systems.
UNIT-II
Friction: Types of Friction-Limiting Friction –Laws of friction-Static and Dynamic Frictions-Motion of Bodies:Wedge,Screw-Jack and Differential Screw-jack.
Transmission of Power: Belt-Drives: Open, Crossed and Compound-Length of Belt, Tensions, Tight side, Slack side, Initial and Centrifugal-Power transmitted and condition for Max.Power.
UNIT-III
Centroid and Centre of Gravity: Centroids –Theorem of pappus-Centroids of composite figures-Centre of gravity of Bodies.
Area moments of Inertia: Definition-Polar Moment of Inertia, Transfer theorem. Moments of Inertia of Composite figures, Product of Inertia, Transfer formula for product of Inertia.
UNIT-IV:
Mass moment of Inertia: Moment of Inertia of Masses, Transfer formula for Mass moment of Inertia, mass moment of inertia of composite bodies.
Kinematics: Rectilinear and Curvilinear motions-Velocity and Acceleration-Motion of Rigid Body-Types and their analysis in planar motion.
UNIT-V:
KINETICS: Analysis as a particle and analysis as a rigid body in Translation-Central Force motion-Equations of Plane motion-Fixed axis Rotation –Rolling Bodies.
Work-Energy method:
Equations for Translation, Work-Energy Applications to particle Motion, Connected System-Fixed axis Rotation and Plane motion.
UNIT-VI:
Mechanical vibrations: Definitions, Concepts-Simple Harmonic motion-Free vibrations, simple and compound pendulums-Torsional Vibrations.
Text books:
Engineering Mechanics, by Ferdinand L.Singer,
Published by Harper Collins.

METALLURGICAL ENGINEERING

II- B.Tech-I Semester **Credits – 4**
4 Periods/week Max. Marks – 80

MATHEMATICS – II

(Common to all Branches)

Effective for the batches admitted in the year 2002 and onwards.

UNIT – I

Matrices – brief review – Inverse of a matrix by adjoint ,elementary row transformations – Rank - Normal form – eachelon form. Augmented matrix – Consistency – solution of system of simultaneous linear homogeneous and non-homogeneous equations.

UNIT – II

Eigen values, eigen vectors – properties – Cayley – Hamilton Theorem (Inverse and powers of a matrix by Cayley – Hamilton theorem).Quadratic forms – positive, negative definite – Diagnolization of matrix. Calculation of powers of matrix – Modal and sprectral matrices Real matrices – Symmetric, skew-symmetric, orthogonal, Linear Transformation – Orthogonal Transformation. Quadratic forms – Reduction of quadratic form to canonical form – index – signature.

Complex matrices : Hermitian, Skew-Herimitian and Unitary – Eigen values and eigen vectors of complex matrices and their properties.

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 sine and cosine expansions.

UNIT – IV :

Formation of Partial differential equations by elimination of arbitrary constants and arbitrary functions – solutions of first order linear (Lagrange) equation and nonlinear (standard type) equations. Method of separation of variables – Classification of second order linear Partial Differential Equations, solutions of one dimensional heat equation wave equation and two-dimensional Laplace's equation under initial and boundary conditions.

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UNIT – V

Fourier integral theorem – Fourier sine and cosine integrals. Fourier transform – Fourier sine and cosine transforms. – properties – Inverse transforms – Finite Fourier transforms. Solution of one dimensional wave, heat equations and two dimensional Laplace's equation by Fourier transforms. Z-transform – Inverse z – transform – properties – Damping rule – shifting rule – Initial and final value theorems.

Convolution theorem – Solution of difference equations equations by Z – transforms.

TEXT BOOKS :

1. A Text Book of Engineering Mathematics Volume – II
   T.K.V.Iyengar, B. Krishna Gandhi and others, S. Chand and Company
2. Engineering Mathematics
   B.V. Ramana, Tata McGraw-Hill 2002
3. Engineering Mathematics – II
   C.Sankaraiah, Vijaya Publications
4. Engineering Mathematics – II
   P.Nageswara Rao, Y. Narsimhulu, Prabhakar Rao

SUGGESTED REFERENCES :

1. Engineering Mathematics
   S.K.V.S.Sri Rama Chary, N. Bhujanga Rao, P.Bhaskara Rao,B.S.Publications 2000
2. Advanced Engineering Mathematics (Eighth edition)
   Erwin Kreyszig John Wiley & Sons (ASIA) Pvt Ltd.
3. Advanced Engineering Mathematics (Second edition)
   Michael D. Green Berg , Prentice Hall
4 Sarveswara Rao Koneru
   Engineering Mathematics Orient Longman (Pvt.) Ltd. 2002 (in press)
5 Engineering Mathematics - II
   N.P.Bali, Laxmi Publications (P) Ltd., New Delhi.

METALLURGICAL ENGINEERING

II- B.Tech. -I Semester — Credits – 4
4 Periods/week — Max. Marks – 80

ELECTRICAL ENGINEERING

UNIT - I

SI units, Ohm's law, series, parallel circuits, Kirchoff's laws, star - delta transformation - magnetic quantities - analysis of simple magnetic circuits - force on a current carrying conductor- electromagnetic induction, Faraday's law, Lenz's law - effects of hysteresis & eddy currents - self and mutual inductances.

UNIT - II

Generation of an alternating emf - average and rms values of alternating quantity - representation of alternating quantities by phase - single phase circuits - resonance - three phase balanced systems - single and three phase power calculations.

UNIT - III

Principle of operation of DC machines - emf equation - types and characteristics of DC generators - torque equation - types and characteristics of DC motors - DC motor starters (three point) - efficiency calculation & Swinburne's test.

UNIT - IV

Construction and principle of operation of single phase transformer - emf equation O.C. & S.C. tests - efficiency and regulation - principle and operation of three phase induction motors - types - slip torque characteristics - principle and operation of alternators - O.C. & S.C. test - regulation by synchronous impedance method.

UNIT - V

Basic principles of indicating instruments - moving coil and moving iron instruments - dynamometer type watt meters - induction type energy meter - measurement of single and three phase power.

BOOKS

1. Electrical Technology - Edward Hughs.
2. Introduction to Electrical Engg. - Naidu & Kamakshaiah
3. Electrical Technology - Vincent Del Toro.

METALLURGICAL ENGINEERING

II- B.Tech. -I Semester **Credits – 4**
4 Periods/week Max. Marks – 80

MECHANICS OF SOLIDS

UNIT 1 Simple Stresses and Strains:

Elasticity, plasticity, ductility, malleability, Hardness and brittleness of materials - Definition of stress - types of stresses compressive, tensile and shear - definition of strain, types of strains - factor of safety.

Elastic limit, Hooke's Law-Young's modulus and shear modulus. Tensile test on mild steel specimen-bars of varying section -Extension of a tapering rod - Stresses in bars of composite section - Temperature stresses - Lateral strain poisson's ratio and volumetric strain-element in a state of simple shear - Stresses on oblique sections. Definition of Bulk modulus, Relation between the three elastic constants - Bars of uniform strength.

UNIT 2 Shear forces and bending moments:

Definition of a Beam, Types of beams - Cantilever, Freely supported overhanging, fixed and continuous beams - Concept of shear force and bending moment - Shear force and bending moment diagrams for cantilevers, freely supported and overhanging beams due to point loads, uniformly distributed load, uniformly varying load and combination of the above loads - point of contra-flexure, relation between shear force and bending moment.

UNIT 3 Flexural Stresses:

Theory of simple bending - Derivation of the equation $M/I = f/y = E/R$ - Neutral axis - Assumptions in the theory of pure bending - Determination of bending stresses - Section modulus of solid and hollow rectangular and circular sections I,T, Channel and Angle sections. Design of simple beam sections.

Shear stresses:

Derivation of governing equation - Shear stress distribution over a cross section - rectangular, circular and structural sections.

UNIT 4 Deflection of beams:

Members bending into a circular arc - Slope deflection and radius of curvature - differential equation for the elastic line of a loaded beam - Deflections in the case of cantilevers, Freely supported and overhanging beams subjected to point loads, uniformly distributed load, uniformly varying load - Macaulay's method - Determination of slope and deflection of cantilevers, simply supported beams, overhanging beams. Mohr's theorems and moment - area method - applications to simple cases.

Thin & Thick Cylinders:

Thin seamless cylindrical shells - Derivation of the formula for hoop stress and longitudinal stress - Hoop strain and longitudinal strain - Volumetric strain. Wire wound thin cylinders. Thick cylinders – Lame's equation – Hoop stress and radial pressure distribution.

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UNIT 5 Principal Stresses and Strains:

Introduction - Stress Components on inclined planes - Two perpendicular normal stresses accompanied with state of Simple shear - Mohr's circle - Determination of principal stresses and principal planes analytically and graphically - Principal strains.

Torsion:

Theory of pure torsion - Torsional moment of Resistance - Assumptions in theory of pure torsion - Polar modulus - Power transmitted by shaft keys and couplings - Shear and torsional resistance - Shafts of circular cross sections - Combined bending and torsion and end thrust - Design of shafts based on theories of failure.

BOOKS:

1. Solid Mechanics by Papov
2. Elementary strength of Materials by Timoshenko & Young
3. Strength of materials and mechanics of solids - Vol. I by BC Punmia
4. Strength of materials by S. Ramamrutham

METALLURGICAL ENGINEERING

II- B.Tech.- I Semester **Credits – 4**
4 Periods/week Max. Marks – 80

DATA STRUCTURES THROUGH C

UNIT-1

STRUCTURES, UNIONS AND FILES : Structure definition , initialising , assigning values, passing of structures as arguments, Unions, operations on files in c,C program examples.

ARRAYS AND STRINGS : Storage structures for arrays and strings, efficient representation of special matrices such as symmetric, band and sparse etc..representation of polynomials and arithmetic on polynomials.

UNIT-2.

LINKED LISTS: Sequential allocation and linked allocation for representing lists, insertion and deletion operations on singly and doubly linked linear lists, pointers in C, Simple programs on linear linked lists in C, Multilinked structures.

UNIT-3.

STACKS AND QUEUES : Array and pointer representations of Stacks and Queues in c , operations on stacks and queues in c, simple applications of stacks and queues in c such as infix to postfix expression conversion,recursion in c, deques and circular queues.

UNIT-4.

TREES : Binary tree representation in c using arrays and pointers , c functions for pre-order, in-order and post-order traversals of a binary tree,binary search tree creation in c, deletion operation on a binary search tree, threaded binary trees, applications of trees.

GRAPHS : Matrix representation of graphs, pointer representation of graphs, graph traversals and spanning trees.

UNIT-5

SORTING : Bubble sort ,selection sort , Insertion sort , Heap sort, algorithms and their C implementations.

SEARCHING : Linear search, Binary search, Fibonacci search, hashing techniques

BOOKS: 1. Programming in C by Balaguruswamy TMH

2. Data structures using C by A.M.Tanenbaum,Y.Langsam and J.Augensteen , PHI

3. An Introduction to Data structures with applications by Tremblay & Soronson, TMH

4. Data structures and Program design in C by Kruse, PHI

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METALLURGICAL ENGINEERING

II- B.Tech. -I Semester **Credits – 4**
4 Periods/week Max. Marks – 80

PHYSICAL METALLURGY

Unit-1:

Microscopy; Metallurgical Microscope, principles and construction, types of objectives and eye pieces, common defects of lenses, electron Microscope.

Unit-2:

Structure of Metals, Hume-Rotherys classification of metals, metallic bond-crystal structure of metals, coordination number, relationship between lattice parameter and atomic radius, packing factor and density calculations, interstitials, polymorphism, plane and directional indices, transformation of indices.

Unit - 3:

Constitution of Alloys: Necessity of alloying, types of solid solutions, Vegards law and Hume Rotherys rules. Intermediate alloy phases, electro-chemical compounds, size factor compounds and electron phases.

Unit-4:

Equilibrium Diagrams: Experimental methods for construction of equilibrium diagrams, Isomorphous alloy systems, types of Nucleation, determination of the size of critical nucleus, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps - eutectic systems, congruent melting intermediate phases, peritectic, monotectic and syntectic reactions, Transformation in solid state, allotropy, order-disorder transformation, eutectoid, peritectoid reactions and complex phase diagrams, relation netween equilibrium diagrams and physical properties of alloys. Study of important binary phase diagrams Fe-Fe_3C, Cu-zn, Cu-sn, and Al-Cu.

Unit-5:

Phase transformations: Phase transformations in steels pearlitic, martensitic and bainitic transformations, cooling curves and isothermal transformation diagrams, transformations on continuous cooling.

BOOKS:

1. Introduction to Physical Metallurgy - S.H. Avner
2. Engineering Physical Metallurgy and Heat Treatment - Y. Laktin.
3. Elements of physical Metallurgy - A. Guy
4. Metallographic laboratory practice - Kehl
5. Principles of Physical Metallurgy - Smith M.
6. Introduction to Metallurgy – Sir Allen Cottrell

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METALLURGICAL ENGINEERING

II- B.Tech.- I Semester **Credits – 4**
4 Periods/week Max. Marks – 80

FURNACE TECHNOLOGY AND PYROMETRY

UNIT-I:Steady State Heat Transfer: Importance of Heat transfer ,conduction through plane, cylindrical, Spherical and compound walls,shape factor and effect of variable thermal conductivity.Dimensional groups.Free and Forced convection.Heat Transferby combined effect o conduction and convection between two fluids separated by a plane wall and cylindrical wall. Types of Heat exchangers on mode of travel.Log mean temperature difference for both parallel and counter flow exchangers.

UNIT-II:Radiation-emissivity-luminous and non-luminous flames. Radiant exchange between parallel surfaces enclosed body and enclosure. Combined effect of conduction ,convection and radiation. Thermal efficiency of insulation. Unsteady state conduction: Thermal diffusivity equation for uni-directional heat flow. Sudden change of surface temperature of a thick plane wall,cylinder and sphere. Graphical Solutions.

UNIT-III: Furnaces: Characteristic features of vertical shaft furnaces, reverberatory furnaces,Arc and Induction furnaces.Tube and muffle type resistance furnaces,continuous furnaces. Sources of heat losses in furnaces and heat balance.

UNIT-IV:Pyrometry: Thermo electric pyrometry- peltier and Thomas e.m.f's . Thermo-electric power of thermocouples. Required properties of thermocouples. Noble and base metal thermocouples. Thermo-pile. Measurement of e.m.f by Milli-voltmeters and potentiometers. Cold junction correction. Resistance thermometers-Callendars correction .Principle, constructiin of resistance thermometers. Measurement of resistance compensation for connection wires.

UNIT-V:Optical pyrometers-principle involved in optical pyrometrs,Black body conditions.Wiens and Plancks laws of monochromatic radiation. Principle,construction and temperature measurement of the following:
1.Disappearing filament-optical pyrometer(Morse type)
2.F and F optical pyrometer(Wedge type) and
3.Pyro-optical pyrometer.
4.Radiation pyrometer.
The effect of the following on optical pyrometer reading:
--Distance between pyrometer and source.
---Emmissivity of materials.
---Absorbing media and reflection.
Text books:

1. Elements of Heat Transfer-Jakob and Hawkins
2. Elements of Thermodynamics & Heat Transfer---Obert & Young.
3. A textbook of Metallographic Laboratory Practice.

METALLURGICAL ENGINEERING

II- B.Tech.- I Semester **Credits – 2**
3 Periods/week Max. Marks – 60

DATA STRUCTURES THROUGH C LAB

1. Implement the Following data structures using Arrays
   a) Stacks.
   b) Linear queues.
   c) Circular queues
   d) De queue

2. Implement polynomial addition and mutiplication with linked list spare matrix.

3. Implement binary search tree using linked list and perform the following operations
   a) Insertion
   b) Deletion
   c) In order Traversal
   d) Pre order Traversal
   e) Post order Traversal

4. Singly linked list and doubly linked lists
   a) Insertion
   b) Deletion
   c) Loop up

5. a) Implement stack using singly linked list
   b) Implement queue using singly linked list

6. Implement the following sorting techniques
   a) Babble sort
   b) Insertion sort
   c) Quick sort
   d) Acap sort

7. Implement the following searching method.
   a) Sequential Search.
   b) Binary search.
   c) Fibonacci search.

8. a) Convertion of Infix expression to post fix notation.
   b) Simple expression evaluation that can handle : +,-,/ and *

METALLURGICAL ENGINEERING

II- B.Tech. -I Semester **Credits – 2**
3 Periods/week Max. Marks – 60

PHYSICAL METALLURGY LAB

LIST OF EXPERIMENTS

1. Preparation and study of Crystal models.
2. Study of: Specimen cutting machine
   Specimen moulding press
   Grinding and polishing equipment
3. Study of various Metallurgical Microscopes and use of levelling press.
4. Metallographic preparation of ferrous specimen for Microscopic examination.
5. Preparation non-ferrous specimen for Metallographic examination
6. Preparation and Metallographic study of pure metals like Iron, Copper, Aluminium.
7. Measurement of lattice parameters of various crystal structures and calculation of packaging factors and size of vacancies.
8. Thermal analysis: Experiments To obtain cooling curves for pure metals and alloys and to establish Binary phase diagram.
9. Drawing of the Binary phase diagram of Isomorphous, simple Eutectic and partial solid solubility diagram with interpretation.
10. Drawing of complex binary phase diagram and identifiction points, lines and areas in them.
11. Study of Microstructures of steels.
12. Estimation of Carbon content of steels using metallurgical microscope and to find the carbon content of the steel by Spark test.

METALLURGICAL ENGINEERING

II B.Tech. -II Semester **Credits – 4**
4 Periods/week Max. Marks – 80

MATHEMATICS – III

(Common to all branches except to Computer Science, Mechanical and Civil Engg., and its allies.)

Effective for the batches admitted in the year 2002 and onwards.

UNIT – I:

Special functions : Gamma and Beta functions – Their properties – evaluation of improper integrals. Bessel functions – Properties – Recurrence relations – Orthogonality Legendre polynomials – properties – Rodrigue's formula – Recurrence relations – Orthogonality.

UNIT – II :

Functions of a Complex variable – Continuity – Differentiability – Analyticity – Properties – Cauchy – Riemann equations in Cartesian and polar coordinates. Harmonic and conjugate harmonic functions – Milne - Thompson method.

Elementary functions: Exponential, trigonometric, hyperbolic functions and their properties – General power z^c, (c is complex) Principal value.

UNIT – III :

Complex integration : Line integral – evaluation along a path and by indefinite integration – Cauchy's integral theorem – Cauchy's integral formula – Generalized integral formula. Zero – singular point – Isolated singular point – pole of order m – essential singularity.

Complex Power series : Radius of convergence – Expansion in Taylor's series, Machaurin's series and Laurent series.

UNIT – IV :

Residue – Evaluation of residue by formula and by Laurent series, Residue theorem. Evaluation of integrals of the type

a). Improper real integral $\int_{-\infty}^{\infty} f(x)\,dx$

b). $\int_{\alpha}^{\alpha+2\pi} f(\cos\theta, \sin\theta)\,d\theta$

METALLURGICAL ENGINEERING

c). Fourier integrals $\int_{-\infty}^{\infty} e^{imx} f(x)\,dx$

d). Integrals by indentation.

Argument principle – Rouche's theorem – determination of number of zeros of complex polynomials. Fundamental theorem of Algebra, Liouville's Theorem.

UNIT – V

Conformal mapping : Transformation by e^z, in z , $z^2 m^1, z^n$ (n a positive integer) sinz, cosz, z + a/z.

Translation, rotation, inversion and bilinear transformation – fixed point – cross ratio – properties – invariance of circles and cross ratio – Determination of bilinear transformation mapping 3 given points.

TEXT BOOKS :

1. A Text Book of Engineering Mathematics Volume – III, 2002
T.K.V.Iyengar, B. Krishna Gandhi and others, S. Chand and Company
2. Engineering Mathematics
B.V. Ramana, Tata McGraw-Hill, 2002 (In press)
3. Engineering Mathematics – III, 2002
C.Sankaraiah, Vijaya Publications (In press)
4. Engineering Mathematics – III, 2002
P.Nageswara Rao, Y. Narsimhulu, Prabhakar Rao (In press)

SUGGESTED REFERENCES :

1. Advanced Engineering Mathematics (Eighth edition)
Erwin Kreyszig John Wiley & Sons (ASIA) Pvt. Ltd. 2001
2. Advanced Engineering Mathematics (Second edition)
Michael D. Green Berg , Prentice Hall, Upper saddal River, New Jersey, 1998
3 Sarveswara Rao Koneru.
Engineering Mathematics Orient Longman (Pvt.) Ltd. 2002 (in press)
4 Engineering Mathematics – III.
N.P.Bali, Laxmi Publications (P) Ltd., New Delhi.

METALLURGICAL ENGINEERING

II B.Tech. -II Semester **Credits – 4**
4 Periods/week Max. Marks – 80

MECHANICS OF FLUIDS

UNIT 1: Fluid properties and Fluid statics:

Density, specific weight, specific gravity, viscosity, Newtonian and Non-Newtonian Fluids, Vapor pressure, compressibility, capillarity, Forces on plane surfaces - total pressure and centre of pressure.

Fluid Kinematics:

Streamline, path line, streakline, stream tube, classification of flows, steady unsteady, uniform, non-uniform, laminar, turbulent, rotational, irrotational flows, one, two and three dimensional flows - Continuity equation, stream function, velocity potential function.

UNIT 2: Fluid Dynamics:

Surface and Body forces - Euler's and Bernoulli's equation for flow along a streamline. Momentum equation, applications, vortex - Free and Forced, Forced vortex with free surface.

Boundary layer flow:

Development of boundary layer along a thin flat plate, Laminar boundary layer and turbulent boundary layer, Laminar sub layer, boundary layer separation, Drag and lift forces - Aerofoils, pressure and form Drags.

UNIT 3: Flow of compressible fluids:

Equation of state, gas laws, Equation of motion, equation of continuity and equation of energy, compressible flow regimes, Mach number, Mach cone. Shock Wave, Stagnation point, flow of compressible fluid through Venturi meter.

UNIT 4: Laminar Flow though conduits:

Flow through closed conduit, Reynold's number, laminar flow through circular tube - horizontal and tubes having slopes. Flow between parallel plates - distribution of shear stress and velocity across the section.

Analysis of Pipe flow:

Darcy - Weibach equation, Hydraulic gradient and total energy lines, loss of Head due to sudden enlargement and contraction, Syphon pipes, parallel pipes, pipes in series, power transmission through pipes.

UNIT 5: Measurement of pressures and flows:

Piezometer, manometers, pressure gauges, venturimeters and orificemeters, flow through notches and weirs, viscometers, Hot wire Anenometers

Books:

1. P.H. Modi & S.M. Seth Fluid Mechanics

2. A.K. Jain - Fluid Mechanics
3. K.L. Kumar - Fluid Mechanics

METALLURGICAL ENGINEERING

II- B.Tech.- II Semester **Credits – 4**
4 Periods/week Max. Marks – 80

BASIC ELECTRONICS

UNIT – I

Semiconductors : P & N Type

PN Junction, Junction Diode, V – I Characteristics, Diode as a Switch & Diode as Rectifier, Basic Filter Circuits. PNP and NPN Junction Transistor. Transistor as an Amplifier. SCR Characteristics and Applications

UNIT – II

Concept of Feedback and Oscillation :

Effect of negative Feedback, and amplifiers, RC Oscillators

UNIT – III

Basic Timer Circuits – Applications Welding Circuits, Resistance Welding . Energy storage Welding

UNIT – IV

Introduction and dielectric heating . Cathode ray tube & CRO, Simple Applications

UNIT – V

Transducers, Measurement of Non – electrical quantities . Ultrasonics – Simple Applications.

REFERENC BOOKS :

1 Industrial Electronics : by G.K. Mithal (Khanna)
2. 'Electronic Instrumentation & Measurement Techniques' by Cooper & Helfrich (3rd Edn)(PHI)
3. Industrial Electronics : by S. N. Biswas, (Dhanpet Roy & Co., 1997).

METALLURGICAL ENGINEERING

II B.Tech. -II Semester **Credits – 4**
4 Periods/week **Max. Marks – 80**

FUELS TECHNOLOGY AND REFRACTORIES

Unit-I:

Introduction to Fuels Technology - Classification of fuels - Origin and Classification of Coal - Analysis of Coal - Proximate and ultimate analysis - Pulverised fuel - Principle of Carbonisation - Manufacture of Metallurgical Coke - Properties of Metallurgical Coke - Testing of Coke.

Unit-II: Principles of production of fuel oils from crude. Manufacture, properties and uses of

a) Producer gas

b) Water gas

Properties and uses of Blast furnace gas and coke – Oven gas

Cleaning of Blast furnace gas.

Unit-III:

Comparative study of solid, liquid and gaseous fuels. Combustion of Fuels- Solving of some simple problems on combustion and calorific value of fuels.

Unit-IV:

Refractories: Desirable properties of refractories. Methods of Classification. Modes of failure of Refractories in service and their prevention. Manufacturing methods and properties of Fireclay, Silica, Magnesite and chrome refractories.

Unit-V:

Testing of Refractories.Application of Refractories in the Metallurgical industries.

Unit-VI:

Refractories: Desirable properties of Refractories. Methods of classification. Modes of failure of refractories in service and their prevention. Manufacturing methods and properties of Fireclay, Silica, Magnesite and Chrome-Refractories,Testing of Refractories. Applications of Refractories in the Metallurgical Industries.

References:

1. Furnaces, Fuels & Refractories - Gupta.
2. Elements of Fuel Technology ---- HIMUS
3. Refractories ---- Norton
4. Refractories ----- Chisti

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METALLURGICAL ENGINEERING

II- B.Tech. -II Semester **Credits – 4**
4 Periods/week Max. Marks – 80

THERMODYNAMICS AND KINETICS

Unit-1:

Properties of gases: Summary of ideal gas laws, kinetic theory of gases and the gas laws, Real gases.

Introduction and definition of terms:

Objectives and limitations to thermodynamics, concepts of system and state, Heterogeneous and homogeneous systems, extensive and intensive properties of system, thermodynamic variables, thermodynamic equilibrium and Zeroth law of thermodynamics.

Unit-2:

First law of thermodynamics: Historical outlines, nature of first law, Relationship between heat and work, internal energy and the first law of thermodynamics, calculations of work, constant volume processes, constant-pressure process, Enthalpy, Heat capacity, Reversible adiabatic processes, Reversible isothermal pressure or volume changes, of an ideal gas, joules experiment, Joule-Thompson experiment, Joule-Thompson co-efficient, Heat of formation, Hess's law and Heats of reaction, variation of enthalpy change with temperature, Kirchoff's equation.

Study state and unsteady state flow analysis.

Second law of thermodynamics: Efficiency of a cyclic process, Carnot cycle, second law of thermodynamics concept of entropy, entropy and quantification of irreversibility, Reversible processes, thermodynamic temperature scales.

Unit-3:

Statistical interpretation of Entropy: Entropy and disorder of most probable macrostate and microstate.Determination of most probable macrostate, effect of temperature, thermal equilibrium within a system and the Boltzmann equation.

Free energy functions:

Purposes of the new functions, definition of Helmholtz and Gibbs free energy change, meaning of thermodynamically possible process, determination of ▲G from thermal data, useful relationships between free energies and other thermodynamic functions, Maxwell's equation and Gibbs-Helmholtz equation.

Unit-4:

Third law of thermodynamics: Background of third law, deductions from third law, applications of third law, other methods of obtaining ▲ S^0 for a reaction.

Fugacity, activity and equilibrium constant:

Concepts of fugacity, activity and equilibrium constant, variation of the equilibrium constant with temperature, Tabular methods recording, thermodynamic data and sigma functions.

METALLURGICAL ENGINEERING

Unit-5:

Claussius - Clapeyron equation: Introduction, derivation of the Claussius - Clapeyron equation for single substance, Durin's rule for the estimation of the vapour pressures of an element, integration of Clausius-Clapeyron equation.

Kinetics:S

Kinetics of chemical processes, Molecularity and order of a reaction, zero order reactions, first order, second order reactions, Determination of order of reaction, collision theory, theory of absolute reaction rates, consecutives and simultaneous reactions, catalysis in chemical reactions.

BOOKS:

1. Introduction to Metallurgical thermodynamics - D.R. Gaskell
2. Physical Chemistry for Metallurgists - J Mackowiak.
3. Thermodynamics of solids - R.V. Swalin
4. Physical Chemistry to Metals - L.S. Darken & R.W. Gurry.
5. An Introduction to Thermodynamics – Y.V.C. Rao
6. Fundamentals of Thermodynamics- Sonntag et al
7. Fundamentals of Engineering Thermodynamics- M.J.Moran and H.N.Shapiro

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METALLURGICAL ENGINEERING

II- B.Tech.- II Semester **Credits – 4**
4 Periods/week Max. Marks – 80

MINERAL DRESSING

Unit-1:

Scope and objectives of ore dressing. Sampling of ores by different methods.Communition laws,Ritinger'slaw,Kicks law and Bonds law.

Theory of liberation of minerals, primary, secondary and special crushers (Jaw, Gyratory, Cone, Rolls and tooth rools crushers)

Unit-2:

Grinding, Ball mills, theory of Ball mill operation, rod and tube mills.

Sizing: Sizing scales, laboratory sizing and reporting data in various numerical and graphical forms, Industrial sizing methods, types of screens and effectiveness of screen.

Unit-3:

Movement of solids in Fluids, stokes and Newton's laws. Terminal velocity and its relation with size. Relation between time and velocity. Relation between distance traveled and velocity. Free and hindered settling ratios.

Unit-4:

Quantifying concentrating operations: Ratio of concentration recovery, selectivity index and economic recovery. Classification principles sizing: Heavy media separation, Jigging, Tabling.

Unit-5:

Principles of flotation,physical and chemical aspects.

Application of flotation process for concentration of copper, lead and zinc ores.

Principles and applications of Magnetic and Electrostatic separation processes. Coal washing methods. Details about Indian ore dressing practices of Cu,Pb,Zn and Fe ores.

Books:

1. Principles of Mineral Dressing by A.M. Gaudin.
2. Elements of Ore Dressing by A.F. Taggart.
3. Principles of ore processing - B.A. Wills.
4. Ore Dressing by S.K.Jain

METALLURGICAL ENGINEERING

II-B.Tech.-II Semester **Credits – 2**
3 Periods/week **Max. Marks- 60**

FUELS TECHNOLOGY AND REFRACTORIES LAB

1. To conduct proximate analysis of Coal
2. To conduct ultimate analysis of Coal
3. To conduct "MICUM" test for Coal
4. To find the Flash and Fire points of fuel oil by "PENSKY MARTIN'S" open and closed cup apparatus.
5. To find the flash and fire point of fuel oil by ABEL's open and closed cup apparatus.
6. To find the viscosity of lubricant oil by using
   i) Red-wood-I Viscometer.
   ii)Red-wood-II Viscometer.
7. To find the Calorific value of solid and liquid fuels by using "BOMB CALORIMETER".
8. To find the Calorific value of gaseous fuels by using "JUNKER'S GAS CALORIMETER".
9. To analyse the fuel gas by ORSAT apparatus.
10. To study various types of Refractories and find their densities, Hardness and Slag Penetration.
11. To find the Refractorieness of a Refractory under load.
12. To conduct spalling resistance test on various refractories.
13. To find the refractoriness of a refractory by pyrometric cone equivalent test.
14. Determination of porosity in a brick.

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METALLURGICAL ENGINEERING

II- B.Tech. -II Semester Credits – 2
3 Periods/week Max. Marks- 60

MINERAL DRESSING LAB

1.Sampling of an ore from the bulk by
   i) Cone and quartering method.
   ii) Riffle sampler.
2. Determining the reduction ratio of a single toggle jaw crusher..
3. Study by Sieve analysis of crushed ore.
4. Study of the variation of reduction ratio with process variables in Rolls crusher.
5. Verification of Stoke's Law.
6. Determination of the efficiency of a jig.
7. Determination of the efficiency of a magnetic separator.
8. Study of the particle separation by fluid flow using wielfly table.
9. Determination of the efficiency of a pneumatic separator.
10. Study of the process variables on reduction ratio and particle size distribution in ball mill.
11. To find the grindability index of ores.
12. Verification of Laws of Communition.
13. To study the concentration of metallic and non-metallic ores by Froth-Floatation process.

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METALLURGICAL ENGINEERING

III- B.Tech.- I Semester **Credits – 4**
4 Periods/week **Max. Marks – 80**

PROBABILITY AND STATISTICS

(Common to Computer ;Science, Civil and Mechanical Engineering)

UNIT – I

PROBABILITY :

Sample space and events – probability - The axioms of probability – Some elementary theorems – conditional probability – Baye's theorem

UNIT – II

PROBABILITY DISTRIBUTIONS :

Random variables – Discrete and continuous – Distribution – Distribution function – Distributions – Binomial, poisson and normal distribution – related properties

UNIT – III

SAMPLING DISTRIBUTION :

Populations and samples – Sampling distributions of mean (known and unknown) Proportions, sums and differences.

UNIT – IV

INFERENCES CONCERNING MEANS AND PROPORTIONS :

Point estimation – Interval estimation – Bayesian estimation – Test of Hypothesis – Means and proportions – Hypothesis concerning one and two means-Type I and Type II errors. One tail, two-tail tests- Tests of significance, - Student t- test, F-tests, - χ^2 test. Estimation of proportions .

UNIT – V

CURVE FITTING :

The method of least squares – inferences based on the least squares estimations – Curvilinear regression – multiple regression- Correlation for univariate and bivariate distributions.

TEXT BOOKS :

1. Probability and Statistics for Engineers by Irwin Miller and John E. Freund. Prentice-Hall of India Private Limited, 6th edition.
2. Engineering Mathematics – B.V. Ramana, Tata McGraw-Hill -2002 (In Press)

REFERENCE BOOK :

1. Probability and Statistics for Engineers. By Walpole and Meyer.
2. Advanced Engineering Mathematics (Eighth edition) Erwin Kreyszig, John Wiley & Sons (ASIA) Pvt Ltd., 2001

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METALLURGICAL ENGINEERING

III- B.Tech.- I Semester **Credits – 4**
4 Periods/week **Max. Marks – 80**

MANAGERIAL ECONOMICS & FINANCIAL ANALYSIS

Unit I Introduction to Managerial Economics

Managerial economics: Definition, nature and scope -Demand analysis: Law of Demand, demand determinants- Elasticity of Demand: definition, types, measurement and significance- Demand Forecasting methods.

Unit II Theory of Production

Firm and industry – Production Function –Cobb Douglas Production Function-Laws of Returns-Internal and External economies of scale.

Cost Analysis: Cost concepts, fixed Vs variable costs, explicit Vs implicit costs, out-of-pocket costs Vs imputed costs, opportunity cost, sunk costs and abandonment costs.

Break-even analysis: Concept of Break-even Point (BEP) - Break-Even Chart - Determination of BEP in volume and value- Assumptions underlying and practical significance of BEP. (Simple Problems).

Unit III Introduction to Markets and Business organisations.

Market Structures – Types of Competition - Features of Perfect competition, Monopoly, Monopolistic Competition –Price-output determination.

Types of Business Organisation –Features, merits and demerits of Sole proprietorship, Partnership and Joint stock companies – Types of companies – Public Enterprises – Types and Features.

Unit IV Introduction to Capital

Capital and its significance –Types of capital – Estimation of Fixed and working capital requirements – Methods of raising capital.

Introduction to capital budgeting methods: Pay back method, Accounting Rate of Return (ARR) and Net Present Value (NPV) method. (Simple Problems).

Unit V Introduction to Financial Accounting and Financial Analysis

Double Entry Book keeping – Journal – Ledger – Trial Balance – Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments.

Ratio Analysis: Computation 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) and Profitability Ratios (Gross Profit Ratio, Net Profit Ratio, Operating Ratio, P/E Ratio and EPS). Analysis and Interpretation.

Books for Reference:

1. Joel Dean, *Managerial Economics,* Prentice Hall of India, 2001.
2. James C. Van Horne, *Financial Management Policy*, Pearson Education Asia, 2001.
3. Varshney & Maheshwari, *Managerial Economics*, S. Chand and Co., 2000.

4. Y. K. Bhushan, *Fundamentals of Business Organisation and Management*, Sultan Chand, New Delhi.
5. Narayana Swamy, *Financial Accounting*, Prentice Hall of India, 2001.
6. A.R. Aryasri, *Managerial Economics and Financial Analysis (MEFA) for JNTU (B.Tech.)*, Tata McGraw-Hill. New Delhi.
7. R.K. Mishra et al, *Readings in Accounting and Finance*.
8. R. L. Gupta, *Financial Accounting*, Volume I , Sultan Chand, New Delhi, 2001.

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METALLURGICAL ENGINEERING

III B.Tech. -I Semester **Credits – 4**

4 Periods/week Max. Marks – 80

PRINCIPLES OF EXTRACTIVE METALLURGY

Unit-I: Unit Processess: Calcination- , Sintering , Pelletizing, Briquetting. Types of Roasting (Oxidising, Roasting ,Sulphatising roasting, Chloridising roasting). Industrial roasting process (Multiple hearth roasting, Flash roasting and fluidized bed roasting, Blast roasting).

Unit-II: Principles of reduction smelting and matte smelting. Industrial Smelting units, viz. reverbaratory, Blast furnace, Electric furnace and flah smelting. Slags and their properties.

Unit-III: Ellingham diagrams for oxides and sulphides-Criteria for reduction.

Unit-IV: Hydrometallurgy:-Principles and types of leaching. Solution purification by ion exchange and solvent extraction. Metal recovery from leach solution by cementation and Electro-winning.

Unit-V:
Principles of refining processes- Fire refining, Distillation, Liquation, Electro refining and zone refining, Simple charge calculations. Pollution control and energy requirements in process metallurgy.

Text books:

1. Non-Ferrous Extractive Metallurgy: HS Ray, K.P Abraham and R.Sreedhar
2. A textbook of Metallurgy by A.R. Bailey

Reference Books:

1. Metallurgy of the Non-Ferrous Metals by W.H.Dennis
2. Metallurgical Engineering Vol.I Engineering Principles by R.H Schumann.

METALLURGICAL ENGINEERING

III B.Tech. -I Semester **Credits – 4**

4 Periods/week **Max. Marks – 80**

HEAT TREATMENT TECHNOLOGY

1. HEAT TREATMENT:

   Annealing, Normalizing, Hardening, mechanism of heat removal during quenching, quenching media, size and mass effect, hardenability, tampering, austempering, surface heat treatment, carburizing, cyaniding, flame and induction hardening, residual stresses and martempering, deep freezing.

2. EFFECT OF ALLOY ELEMENTS:

   Purpose of alloying, effect of alloying elements on ferrite, cementite, Fe-Fe_3C system, tempering and TTT Curves.

3. ALLOY STEELS:

   Structural and constructional steels, maraging steels, tool and die steels, corrosion and heat resistant steels, Hadfield steels, magnetic steels and alloys, free machining steels.

4. CAST IRONS:

   White cast iron, grey cast iron, spheroidal graphite iron, malleable cast irons, alloy cast iron.

5. NON-FERROUS METALS AND ALLOYS:

   Precipitation hardening, ageing treatment, study of copper and its alloys , aluminum and its alloys, nickel and its alloys, titanium and its alloys, magnesium and its alloys, lead, tin and their alloys and die casting alloys.

6. Heat treatment furnaces, their design, atmosphere control vacuum heat treatment etc.,

TEXT BOOKS:

1. Physical Metallurgy – Lakhtin
2. Physical Metallurgy – Clark and Varney
3. Physical Metallurgy Principles – Reed – Hill.
4. Heat Treatment of Metals- Zakharov.
5. Heat Treatment Principles and Techniques- Rajan & Sharma.
6. Physical Metallurgy- V. Raghavan.

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METALLURGICAL ENGINEERING

III-B.Tech.- I Semester **Credits – 4**

4 Periods/week Max. Marks – 80

METALLURGICAL THERMODYNAMICS

1. DIFFUSION:

   Ficks law of diffusion and its application, Kirkendal effect, Darken's equations, the Metano Method, determination of intrinsic diffusivities, self diffusion in pure metals, Temperature dependence of the diffusion coefficient, diffusion along grain boundaries and surfaces.

2. ELLINGHAM DIAGRAMS:

   Introduction, calculation of equilibrium constants from standard free energy changes, general description of Ellingham diagrams, Interpretation of two or more free energy change Vs. temperature lines taken together, derivation and uses of the oxygen, nomographic scale in Richardsons diagrams.

3. THERMAL PROPERTIES:

   Specific heats of solids, classical, Einstein and Debye's Model of the lattice, specific heat of solids, anharmonicity, thermal expansion, thermal conductivity of solids, lattice thermal conductivity and thermo-electric effects. Stability of Crystal disorders.

4. SOLUTIONS:

   Composition, partial molal quantitites, ideal solutions, Raoults Law, actual (Nonideal) solutions, Sieverts law, Gibbs' – Duhem equation, integration of Gibbs' – Duhem equation, Excess thermodynamic quantitites.

5. APPLICATION TO PHASE DIAGRAMS:

   Concept of chemical potential, equality of chemical potentials in equlibrated phases, Derivation of Gibbs' phase rule, solidus and liquidus lines for an ideal solution, calculation of liquidus line for eutectic systems.

6. REVERSIBLE CELLS:

   Electro-Chemical cells, galvanic cells, chemical and electrical energy, thermodynamics of Electro-chemical cells, standard electrode epotentials, sign convention of electrode potentials, application of Gibbs –Helmholtz equation to galvanic cells. Concentration Cells.

Text Books:

1. Physical Chemistry for Metallurgist – J. Mackowick
2. Physical Chemistry of Metals – LS Darken and Gurry

Ref. Books

1. Thermodynamics of solids RA Swalin
2. Physical Metallurgy Principles – RH Reed Hill.

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METALLURGICAL ENGINEERING

III-B.Tech. -I Semester **Credits – 4**

4 Periods/week **Max. Marks – 80**

TECHNIQUES OF METAL JOINING

UNIT I & II:

The principles and theory, mechanism and key variables of different welding processes, types of tooling and equipment, micro-structure of fusion and heat affected zone, welding stresses, pre and post treatments, advantages, disadvantages and field of application of the welding with reference to the following welding processes, Gas welding, Arc welding, submerged are welding, TIG, MIG, plasma are welding,

UNIT III:

Electron Beam welding, Spot welding, Laser welding, Diffusion welding, welding of structural steel welding of cast iron, welding of stainless and other high alloyed steels, welding of copper and its alloys, welding of aluminum and its alloys, joining of dissimilar alloys.

UNIT IV:

Microstructural Changes in Welded joints.

Welding defects and remedies.

UNIT V:

Mechanism, Techniques and scope of brazing, soldering and adhesive bonding process.

REF. BOOKS:

1. JF Lancaster: Welding Metallurgy
2. Little: Welding and Welding Technology
3. Agarwal Manghmani: Welding Engineering
4. BE Rossi: Welding Engineering

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METALLURGICAL ENGINEERING

III -B.Tech.- I Semester **Credits – 2**

4 Periods/week Max. marks-80

PRINCIPLES OF EXTRACTIVE METALLURGY LAB

List of Experiments:

1. Pyrometry:

1.1 Calcination: To demonstrate the phenomenon of differential calcinations (of dolomite).

To study the effect of temperature on rate of calcination of dolomite or lime stone.(Temperatures 500,550,600,650 and 750 degrees celsius)(Time : 1 hour)

To study the effect of time on rate of calcinations of dolomite or lime stone.

(Time: 15 mts,30 mts,45 mts,60 mts,75 mts- Temperature 600^0C)

1.2 Roasting:

To demonstrate the hearth roasting of Zinc or lead concentrate.

To study the effect of time on roasting.

2. HydroMetallurgy:

2.1 Leaching of MgO:

To demonstrate the phenomenon of leaching.
To study the effect of concentration of leach liquor on the rate of leaching.
To examine the effect of pH of leach liquor on leaching.
To study the effect of stirring speed on rate of leaching.

2.2 Recovery of metallic values from leach liquid:
To demonstrate the cementation process and to precipitate copper values from pregnant solution.

3. Electro Metallurgy:

3.1 Electro Winning:
To examine the recovery of metallic values of electro winning of copper sulphate/Zinc Sulphate leach liquid.(Weight deposited is calculated.)
To determine the current efficiency of the cell.

3.2 Electro Refining:
To demonstrate the Electro refining of copper.
To find out the purity of electro refined copper and compare with that of the impure copper.

3.3 Electro forming , electro plating, electro polishing and electro etching:
To demonstrate the phenomena of electro forming using copper sulphate solution.
To determine the thickness of the deposited copper layer and to study the Faraday's laws of electrolysis.
To prepare the sample for metallographic examination by electro polishing and electro etching.(Ortho phosphoric acid solution –Stainless cathode- Brass anode.)

To study the differences between electro plating , electro polishing, electro etching, electro forming, electro refining, and electro winning techniques.

4. Preparation of burden for extraction:

4.1 Agglomeration techniques:

4.1.1 Sintering: To demonstrate the phenomena of sintering.

4.1.2 Pelletizing: To demonstrate the palletizing using a laboratory scale disc pelletizer.

4.1.3 Briquetting: To demonstrate briquetting.

4.1.4 Testing of prepared burden, shatter index test.

Note: Ant twelve experiments to be conducted.

III- B.Tech. -I Semester **Credits – 2**

3 Periods/week Max. marks-60

HEAT TREATMENT TECHNOLOGY LAB

List of Experiments:

1. Annealing of medium carbon steel and observation of micro structure.
2. Normalizing of medium carbon steel and observation of micro structure.
3. Hardening of medium carbon steel and observation of micro structure.
4. Study of tempering characteristics of water quenched steel.
5. Study of age hardening phenomenon in duralumin.
6. Spheroidizing a given high carbon steel.
7. Study of case hardening by pack carburising of low carbon steel.
8. Finding the hardenability of medium carbon steel by Jominy end Quench Test.
9. To conduct Re-crystalization studies on cold worked copper.
10. To conduct case hardening by cyanide bath.
11. To compare the properties of Martempered and Simple tempered steel.
12. To construct and study a TTT diagram of an eutectoid steel.

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METALLURGICAL ENGINEERING

III-B.Tech.- II Semester **Credits – 4**

4 Periods/week Max. Marks – 80

MANAGEMENT SCIENCE

(COMMON FOR ALL BRANCHES)

Unit I:

Introduction to Management

Concepts of Management and Organisation – Functions of Management – Evolution of Management Thought: Taylor's Scientific Management, Fayol's Principles of Management, Douglas Mc-Gregor's Theory X and Theory Y, Mayo's Hawthorne Experiments, Hertzberg's Two Factor Theory of Motivation, Maslow's Hierarchy of Human Needs – Systematic Approach to Management - Principles of Organisation – Types of Organisation, Types of Organisation Structure: Line Organisation, Functional Organisation and Line and Staff Organisation, Matrix Organisation – Managerial objectives –Social Responsibilities.

Unit II:

Introduction to Operations Management

Types of Plant layout – Methods of Production: Job, Batch and Mass Production.

Work-study: Basic Procedure involved in Method study and Work Measurement.

Statistical Quality Control.

Materials Management-Objectives of Inventory Control – EOQ-ABC Analysis – Purchase procedure – Stores Management and Stores Records.

Marketing: Marketing vs Selling, Marketing Mix, Stages in Product Life Cycle, Channels of Distribution.

Unit III:

Introduction to Human Resource Management (HRM)

The concepts of HRM, Human Resource Development (HRD) and Personnel Management & Industrial Relations (PMIR)-HRM vs PMIR, Basic functions of HR Manager: Manpower Planning, Recruitment, selection, training, development, placement, wage and salary administration promotion, transfer, separation, performance appraisal, grievance handling and welfare administration, Job Evaluation and Merit Reading.

Unit IV:

Introduction to Strategic Management

Corporate Planning process: Mission, goals, objectives, policy, strategy, programmes-Elements of Corporate planning process -Environmental Scanning: External Environment Analysis, Internal Environment Analysis, SWOT Analysis- Stages in Strategy Formulation and Implementation.

Unit V:

Introduction to PERT/CPM

Network analysis- project management - Programme Evaluation and Review Technique (PERT) vs Critical Path Method (CPM) - Identifying critical path-Probability of completing the project within given time under PERT, Project cost analysis, project crashing.

METALLURGICAL ENGINEERING

Books for Reference:

1. Koontz and O'Donnel, *Principles of Management*, McGraw-Hill, 2001.
2. Phillip Kotler, *Marketing Management*, Pearson Education Asia, 2002.
3. Gary Dessler, *Human Resource Management*, Pearson Education Asia, 2002.
4. L.S.Srinath, PERT / CPM, Affiliated East-West Press, New Delhi, 2000.
5. W.Glueck & L.R.Jauch, *Business Policy and Strategic Management*, McGraw-Hill. 1998.
6. A.R.Aryasri, *Management Science for JNTU (B. Tech.)*, Tata McGraw-Hill, 2002.
7. O.P.Khanna, *Industrial Engineering & Management*, Dhanpat Rai, 1999.
8. Chandra Bose, *Management and Administration*, Prentice Hall, 2002.

METALLURGICAL ENGINEERING

III- B.Tech. -II Semester **Credits – 4**

4 Periods/week Max. Marks – 80

NON-FERROUS EXTRACTIVE METALLURGY

UNIT I;

COPPER:

Principal Ore Minerals; Matte smelting – Blast furnace, Reverberatory, Electric furnace, Flash; Converting; Continuous production of blister Copper; Fire refining; Electrolytic refining; Hydro-Metallurgical copper extraction; Leaching processes, Recovery of copper from leach solutions; Electro-winning.

UNIT II:

ZINC:

General Principles; Horizontal and vertical retort processes; Production in a Blast furnace; Leaching purification; Electrolysis, Refining.

LEAD:

Blast furnace smelting, Refining of lead bullion

UNIT III:

ALUMINIUM:

Bayer process; Deville – Pechiney process; Hall – Heroult process; Anode effect; Efficiency of the process; Refining, Alternative processes of aluminum production.

UNIT – IV:

MAGNESIUM

Production of Anhydrous Magnesium chloride from sea water and magnesite. Electro-winning practice and problem, refining, Pidgeon and Hansgrig processes.

TITANIUM:

Upgrading of ilemenite, chlorination of titania. Kroll's process. Refining.

UNIT – V:

URANIUM:

Acid and alkali processes for digestion of uranium ores, Purification of crude salt, Production of reactor grade UO_2 and uranium. Simplified flow sheets for the extraction of nickel, tungsten and gold. Review of non-ferrous metal industries in India.

TEXT BOOKS:

1. Extraction of Non-Ferrous Metals – HS Ray, KP Abraham and R. Sridhar
2. Metallurgy of Non-Ferrous Metals – WH Dennis
3. General Metallurgy – N. Sevryukov, B. Kuzmin and Y. Chelishchev.
4. Nuclear Chemical Engineering – Manstion Bendict and Thomas H. Pigfort.

REFRENCES:

1. Rare Metals Hand book - C.A. Hampel
2. Nuclear Reactor Engineering - S. Glass Stone and A.Sesonske

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METALLURGICAL ENGINEERING

III- B.Tech. -II Semester Credits – 4

4 Periods/week Max. Marks – 80

MECHANICAL METALLURGY

UNIT - I

DISLOCATION:

Critical resolved shear stress. Defects in crystalline materials – Point defects and line defects. The concept of a dislocation – Edge dislocation and screw dislocation. Interaction between dislocations. Energy of a dislocation. Jogs, Forces acting on dislocations. Frank Reed source, slip and twinning.

UNIT – II

HARDNESS TESTING:

Methods of Hardness testing (Brinell, Vickers, Rockwell, shore and Poldi methods) Micro-hardness test. Relation between hardness and other mechanical properties.

TENSION TESTING:

Mechanism of classic action, linear elastic properties. Engineering stress-strain and True stress-strain curve. Tensile properties, conditions for necking, effect of temperature and strain rate on tensile properties.

STATIC COMPRESSION:

Elastic and in-elastic action in compression, elastic and in-elastic properties in compression: The compression Test.

UNIT – III:

IMPACT TESTING:

The brittle failure problems Notch sensitivity. Charpy and Izod Testing, V and U-Notch testing, fracture toughness testing – COD and CTOD tests, Fracture toughness as a design criterion. Notched bar impact test significance and specialized test for transition temperature, Metallurgical factors affection – transition temperature temper embrittlement phenomena.

UNIT – IV:

FRACTURE:

Elementary theories of fracture, Griffiths theory of Brittle fracture, Ductile Fracture.

FATIGUE TESTING:

Significance of fatigue test, stress cycles SN Curve , Fatigue limit. Mechanism of fatigue failure, effect of stress concentration, size, surface condition and environments on fatigue, effect of met. Variables on fatigue properties, fatigue testing machines.

CREEP TESTING:

Significance of creep test. The creep curve, creep properties of metals. Stress-rupture test. Deformation and fracture at elevated temperature, theories of creep. Prediction of long time properties. High temperature alloys. Effect of Metallurgical variables on creep. Creep Test.

METALLURGICAL ENGINEERING

UNIT – V:

NON-DESTRUCTIVE TESTING:

Principles and limitations of Penetrant Test, Magnetic, Radiographic. Ultrasonic and Eddy current tests.

TEXT BOOKS:

1. Mechanical Metallurgy – GE Dieter
2. Engineering Materials Science – CW Richards.

MET-2002

METALLURGICAL ENGINEERING

III- B.Tech. -II Semester | Credits – 4

4 Periods/week | Max. Marks – 80

FOUNDRY TECHNOLOGY

UNIT – I:

Scope and development of Foundry. Types of foundries.

PATTERNS:

Materials for patterns, types of patterns, functions and pattern allowance.

MOULDING MATERIALS:

Moulding sands, properties and selection of materials and additives used.

UNIT – II:

CASTING PROCESSES AND EQUIPMENT:

Green and dry sand moulding shell moulding, CO_2 moulding. Core moulds and cores. Plaster mould casting, composite mould casting, Investment casting, permanent mould casting, pressure die casting, Gravity die casting and centrifugal casting, Types of moulding equipment.

GATING AND RISERING:

Gate nomenclature, gate types and types of risers.

SOLIDIFICATION IN METALS:

Nucleation crystal growth. Freezing of metals and alloys. Dendritic freezing. Coring and segregation, ingot defects, Flow of metals in moulds.

UNIT – III:

MELTING OF FERROUS ALLOYS:

Melting of Gray iron and cupola. Cupola operation and control. Effect on chemical composition, carbon equivalent and effect of alloying elements on foundry characteristics. Melting of non-ferrous alloys: Melting of Aluminium and copper alloys production processes; Production of Gray Iron, ductile iron ,Malleable iron castings.

UNIT – IV:

MODERN DEVELOPMENT:

Recently developed processes – v- forming full mould process – Furon-no-bake sand moulds and cores. Continuous casting. Cold setting and self setting processes.

UNIT – V:

CASTING DEFECTS:

Casting defects arising due to moulding, coring melding and poring practice.

TEXT BOOKS:

1. Principles of Metal casting by Heine, Loper Rosenthal.
2. Foundry Technology – Jain

REF. BOOKS:

1. Metals Hand book Vol. 5 published by ASM, Ohio.

METALLURGICAL ENGINEERING

III- B.Tech. II Semester **Credits – 4**

4 Periods/week **Max. Marks – 80**

IRON PRODUCTION

UNIT – I:

Manufacture of Iron and Steel in ancient India. World production of iron and steel. Occurrence and distribution of iron ores. Iron ores of India, Preparation of Iron ores – Concentration. Sintering and palletizing.

UNIT – II:

BLAST FURNACE AND ACCESSORIES:

General features, construction of furnace, foundation, hearth, tuyeres, bosh and bosh angles, stack and top. Furnace lining, Moisting appliances, Trend of modern improvements in blast furnace construction. Blast furnace stoves. Dust catcher and gas mains, cleaning of blast furnace gas and utilisation.

UNIT – III:

Smelting of iron ore in the blast furnaces. Chemistry of smelting. Study of the physical chemistry of the distribution elements in molten metal and slag.

UNIT – IV:

BLAST FURNACE SLAGS:

Constituents of Iron Blast Furnace Slags, Effect of CaO, SiO_2, Al_2O_3, MgO on fluidity of slags. Sillicon and Sulphur control with Indian blast furnace slags.

UNIT – IV:

Blast furnace plant, operation and other details. Common operating troubles, causes and remedies. Blast furnace burden calculations, modern development in blast furnace practice and methods of increasing production. Composition and grading of pig iron.

UNIT – V:

Electric pig iron smelting process. Low shaft blast furnaces. Sponge iron production – Hyl process, SLRN process etc., Production of wrought iron.

TEXT BOOKS:

1. Manufacture of Iron and Steel – Vol. 1, by G.R.Bashforth.
2. Making, shaping and treating of steels by United Steel Corporation, Pittsburg.

REF. BOOKS:

1. Blast furnace theory and practice Vol. 1 and 2 edited by Julius H. Straussburger.

METALLURGICAL ENGINEERING

III- B.Tech.- II Semester **Credits – 4**

4 Periods/week Max. Marks – 80

X-RAY METALLOGRAPHY

UNIT – I:

Production and properties of x-rays. Streographic projection, Bragg's law of diffraction. Diffraction directions and diffraction methods.

UNIT – II:

Intensity of Diffracted beams – Scattering by an electron by an atom, by a unit cell, structure-factor calculations; factors to be considered in calculating the intensities.

UNIT – III:

Experimental Methods – Laue Photographys; Powder photographs, Debye – Sche methods, focussing cameras, pin hole photographs; Diffractometer measurements.

UNIT – IV:

Applications – Orientation of single crystals, Laue method, Diffractometer method, effect of plastic deformation, The structure of polycrystalline Aggregates, crystal size crystal perfection, crystal orientations; Determination of crystal structure, precise parameter measurements.

UNIT – V:

Applications – phase – diagram determination; order- disorder transformation; chemical analysis fby Diffraction, Qualitative analysis, quantitative analysis, stress measurement.

Text Books:

1. Elements of X-ray diffraction by BD Cullity

Ref. Books:

1. Structure of Metals – GS Barrett and TB Masallski , 2nd Edition.
2. X-ray diffraction methods – EW Nuffield.

METALLURGICAL ENGINEERING

III- B.Tech.- II Semester **Credits – 4**

4 Periods/week Max. Marks – 80

MECHANICAL METALLURGY LAB

List of Experiments:

1. Hardness Test:
   - to determine the Brinell Hardness Values of values of ferrois and non-ferrous samples.
2. Tension Test:
   - to determine the elastic modulus, ultimate tensile strength, breaking stress, percentage elongationed percentage reduction in area of the given specimen.
   - To determine the strain distribution along the gauge length.
3. Torsion Test:
   - To determine the modulus of rigidity of given material.
4. Impact Testing:
   - To determine the charpy and Izod (V & U Groove notch) values of a given material at room temperature.
   - To establish the ductile – brittle transition temperature of the material.
5. Fatigue Test:
   - To determine the number of cycles to failure of a given material at a given stress.
6. Magnetic flaw detector:
   - To inspect a given material for cracks.
7. Liquid penetrant Test:
   - To detect the surface flaws in a given material by die penetrant.
8. Ultrasonic flaw detection:
   - To inspect a given material for locating cracks.
9. To detect the surface flaws in steel by florescent penetrant method.
10. To determine the Rockwell hardness values of heat treated steels.
11. To find the microhardness of phases by using vickers hardness tester.
12. To study the radiographs of weldments.

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METALLURGICAL ENGINEERING

III- B.Tech. -II Semester **Credits – 2**

3 Periods/week Max. marks-60

FOUNDRY TECHNOLOGY LAB

List of experiments:

1. Preparation of gating system using green sand.
2. Study of particle size distribution of the sand.
3. Study of the variation of permeability of the green sand with clay and water.
4. Determination of the variation of sand properties like green hardness, green compact strength with additives in sands.
5. Determination of the variation of hot compact hardness and hot shear strength with additives in sands.
6. Determination of clay content in sand.
7. Determination of the shatter index of green sand.
8. Founding of Aluminum and Cast Iron alloys in a pit furnace and casting into light components.
9. Charge calculations and melting practice of cast iron in a cupola.
10. Preparation of a shell by shell moulding process.
11. Making of pipes by centrifugal casting process.
12. Non-destructive testing of a few cast iron components.

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METALLURGICAL ENGINEERING

IV B.Tech.- I Semeater **Credits – 4**

4 Periods/week **Max. Marks – 80**

ELECTRO METALLURGY AND CORROSION

UNIT – I:

Applied Electro-chemistry- electrochemcial methods of analysis, estimation by electrolysis apparatus-potentiometry -conductivity – electrophoresis – measuring instruments for experimental study of electro chemistry.

UNIT – II:

Review of electro-chemical Principles. Theory of conduction EMF its measurement and application. Electrolysis decomposition potential, polarisation over voltage. General discussion on the electrowinning metals eg.Cu, Zn and Sn.

UNIT – III:

Discussion of testing methods and applications of electro-deposite including anodising.

UNIT – IV:

CORROSION:

Types of corrosion and theory of corrosion attack, Tests for corrosion resistance, General corrosion, Pitting corrosion stress corrosion, cracking, Galvanic corrosion, selection of materials for corrosion service, use of inhibitors, surface protection methods including painting, metallic coatings and cathodic protection, Sacrificial anodes.

UNIT – V:

Fundamentals of Electro chemical attack, Galvanic series. Intergranular corrosion and dezincification, corrosion-fatigue.

BOOKS:

1. Electro Metallurgy by Blum.
2. Principles of Electro Metallurgy by Sharan & Narayan.
3. Corrosion Engineering by Fontana.

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METALLURGICAL ENGINEERING

IV- B.Tech. -I Semester **Credits – 4**

4 Periods/week **Max. Marks – 80**

STEEL MAKING

UNIT – I:

Early processes for conversion of Iron into steel: Probable ancient methods, cementation process, crucible process.

THE PNEUMATIC STEEL MAKING PROCESS:

Acid and basic Bessemer processes construction and lining, raw materials for both the processes, operation of the converter, chemistry of the processes, ID LD AC Kaldo: Rotor-Oxygen steel making processes.

UNIT – II:

OPEN HEARTH STEEL MAKING:

General layout of a modern open Hearth furnace, its general features, Refractories used in the bottom, hearth, roof and slag pockets of acid and basic furnaces, regenerators, port ends, flue systems, reversing and controlling equipment. Fuels and raw materials used for the open hearth process. Physical chemsitry of steel making. Slag forming process, oxidation of carbon, silicon and Manganese, desulphurisation, dephosophorization and deoxidation of steel. Recarburisation.

The acid and basic open-hearth processes, recent developments leading to increased production. Titling open hearth furnaces.

UNIT – III:

ELECTRIC FURNACE STEEL MAKING:

Various electric processes, their limitations and advantages, basic electric are furnace process, chemistry of the process, induction furnace process.

UNIT – IV:

Ladle Metallurgy incorporating Vacuum Degassing, Argon Rinising, Ladle Desulphurisation etc. Effect of Elements (C, Si, Mn, SP etc.,) on steel properties and their control during steel making.

UNIT – V:

MISCELLANEOUS:

Duplex and Triplex processes, pitside practices, brief outline of manufacture of alloy steels. Latest developments: (AOD, VOD, VAD & VAR ESR Processes) Details about Indian Practices in various plants.

Continuous casting (Concast) as a method of making steel products.

REF. BOOKS:

1. Making shaping and Treating of steels by united steel corporation, Pittsburgh.
2. Open Hearth furnace practice – Bornatsky.

TEXT BOOKS:

1. Manufacture of Iron and Steel, Vol. II by G.R.Bashforth.
2. Modern Steel making by R.H. Tupkary.

METALLURGICAL ENGINEERING

IV- B.Tech.- I Semester **Credits – 4**

4 Periods/week Max. Marks – 80

MECHANICAL WORKING OF METALS

UNIT – I:

STRESS AND STRAIN FRELATIONSHIP FOR ELASTIC BEHAVIOUR:

Description of stress at a point. State of stress in two dimensions. Mohrs circle of stress in two dimensions. Description of strain at point.

UNIT – II:

ELEMENTS OF THEORY OF PLASTICITY:

The flow curve. True stress and true strain. Von Mises distortion energy criterion, maximum shear stress or Tresses criterion. Octahedral shear stress and shear strain. Basics of the theories of plasticity.

UNIT – III:

FUNDAMENTALS OF METAL WORKING:

Classification of forming processes, Mechanics of metal working for slab method and uniform deformation energy method. Cold working Recovery, recrystallisation and grain growth, hot working. Strain-Rate effects. Work of plastic deformation.

FORGING:

Classification of forging processes, forging equipment. Forging in plane strain. Open-die forging, closed-die forging, Forging of a cylinder in plane-strain. Forging defects, powder metallurgy forging.

UNIT IV:

ROLLING OF METALS:

Classification of rolling process, rolling mills. Hot rolling, cold rolling, rolling of bars and shapes, forging and geometrical relationships in rolling, simplified analysis of rolling load, rolling variables, problems and defects in rolled products. Theories of hot rolling torque and horsepower theories of cold rolling torque and horsepower.

UNIT – V:

EXTRUSION:

Classification of extrusion processes, extrusion equipment. Hot extrusion. Deformation and defects in extrusion. Analysis of the extrusion process, Cold extrusion. Extrusion of tubing and production of seamless pipe and tubing.

DRAWING OF RODS, WIRES AND TUBES:

Rod and wire drawing, tube drawing processes, Residual stresses in rod, wire and tubes.

TEXT BOOKS:

1. Mechanical Metallurgy by GE Dieter (3rd edition)

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METALLURGICAL ENGINEERING

IV- B.Tech.- I Semester **Credits – 4**

4 Periods/week Max. Marks – 80

SEMICONDUCTORS AND MAGNETIC MATERIALS

(Elective - I)

Unit – 1, 2 & 3:

Review of electron theory of metals – electrical and thermal conductivity – theory of electrical conduction – Temperature dependence of electrical conductivity – Hall effect. Elemental and compound semiconductors and their application – Single crystal – Oriented Poly crystal and amorphous semiconductors. Ionic conductivity in solids – Super conductivity – Super conducting materials – structure and application.

Unit – 4 & 5:

Different types of magnetism and their origin – Ferromagnetic, antiferromagnetio and ferrimagnetic materials – Soft and hard magnetic materials – characteristics and applications.

Suggested reading:

1. R.M.Rose, L.A.Shepard, and J.Walf, Structure and Properties Vol. IV Wiley.
2. R.E. Hummel, Electronc properties of materials springer.

METALLURGICAL ENGINEERING

IV- B.Tech.- I Semester **Credits – 4**

4 Periods/week Max. Marks – 80

NON-DESTRUCTIVE TESTING METHODS
(ELECTIVE – I)

UNIT – I:

INTRODUCTION.

VISUAL METHODS:

Optical aids, In-situ metallography, Optical holographic methods, Dynamic inspection.

PENETRANT FLAW DETECTION:

Principles; Process; Penetrant systems; Liquid-penetrant materials; Emulsifiers; cleaners; developers; sensitivity; Advantages; Limitations; Applications.

UNIT – II:

RADIOGRAPHIC METHODS:

Limitations; Principles of radiography; soruces of radiation, Ionising radiation – X-rays sources, r-ray sources Recording of radiation; Radiographic sensitivity; Fluoroscopic methods; special techniques; Radiation safety.

UNIT – III:

ULTRASONIC TESTING OF MATEIRALS:

Advantages, disadvantages, Applications, Generation of ultrasonic waves, general characteristics of ultrasonic waves; methods and instruments for ultrasonic materials testing; special techniques.

UNIT – IV:

MAGNETIC METHODS:

Advantages, Limitations, Methods of generating fields; magnetic particles and suspending liquids Magnetography, field sensitive probes; applications. Measurement of metal properties.

UNIT – V:

ELECTRICAL METHODS:

Eddy current methods; potential-drop methods, applications.

ELECTROMAGNETIC TESTING:

Magnetism; Magnetic domains; Magnetization curves; Magnetic Hysteresis; Hysteresis-loop tests; comparator – bridge tests, Absolute single-coil system; applications.

OTHER METHODS:

Acoustic Emmission methods, Acoustic methods; Leak detection; Thermal inspection.

TEXT BOOKS:

1. Non Destructive Testing by P. Halmshaw

REF. BOOKS:

1. Metals Handbook Vol. II, Nondestructive inspection and quality control.

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METALLURGICAL ENGINEERING

IV- B.Tech.- I Semester **Credits – 4**

4 Periods/week Max. Marks – 80

CERAMICS AND COMPOSITE MATERIALS
(ELECTIVE-I)

Unit I and II: Ceramic Materials: Introduction:- Crystalline –Ccramic phases-Non Crystalline ceramics-Ceramic phase diagrams and their use, the response of ceramic materials to stress, clay and clay products ,crystalline ceramics, glasses cement and cement products-concrete shapes-refractory and insulating materials- Earthern ware, stone ware china,ovenware and porcelain, abrasives.

Unit-II, IV and V: Composite Materials: Introduction, Dispersion-Strengthened composite materials-particle –reinforced materials-Metals-ceramic mixtures-cements-particles-reinforced polymers-fibre reinforced metals and their applications- fiber plastics-composite materials produced from eutectic alloys.

Text books:

1. Properties of Engineering materials:-J.B.Moss
2. Engineering materials and their applications-Flinn and Trojan

Reference Books:

1.Handbook of fiber-reinforced composite materials. Ed.G.Lubin.

METALLURGICAL ENGINEERING

IV- B.Tech.- I Semester **Credits – 4**

4 Periods/week Max. Marks – 80

COMPUTER GRAPHICS AND MULTIMEDIA SYSTEMS

(ELECTIVE – I)

UNIT – I:

GEOMETRY AND LINE GENERATION:

Points, Lines, Planes, Vectors, Pixels and frame buffers, Vector and character generation.

GRAPHICS PRIMITIVES:

Display devices, primitive operations, Display-file structure. Display control Text.

POLYGONS:

Polygon representation, Entering polygons, Filling polygons.

UNIT – II:

TRANSFORMATIONS:

Matrices, Transformations, Transformation routines, Display procedures.

SEGMENTS:

Segment table, Creating Closing, Deleting and Renaming a segment, Visibility, Image transformations.

UNIT – III:

WINDOWING AND CLIPPING:

Viewing transformations, Clipping, Generalized clipping, Multiple windowing.

INTERACTION:

Hardware, Input device handling algorithms, Event handling, Echoing, Interactive techniques.

UNIT – IV:

THREE DIMENSIONS:

3D Geometry, Primitives, Transformations, Projection, Clipping.

HIDDEN SURFACES AND LINES:

Back-face removal, Algorithms, Hidden-line methods.

UNIT – V:

LIGHT, COLOR, AND SHADING:

Illumination, Reflections, Shading algorithms, Shadows, Colors.

CURVES AND FRACTALS:

Curve generation, B. Splines Bezier Curves, Fractals.

TEXT BOOKS:

1. Harrington S, Computer Graphics – A Programming Approach, Second Edition, Mc. Graw Hill, 1987.

ADDITIONAL READING:

Computer graphics – FS Hill Jr. Macmillan Publishing Company – New York.

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METALLURGICAL ENGINEERING

IV- B.Tech.- I Semester **Credits – 4**

4 Periods/week Max. Marks – 80

CAD/CAM

(ELECTIVE – II)

1. INTRODUCTION:
   Definition of CAD/CAM, product bycle and CAD/CAM automation.
2. FUNDAMENTALS OF CAD/CAM:
   Design process – Applications of Computers for design – creating the manufacturing data base – benefits of CAD.
3. CAD HARDWARE AND SOFTWARE:
   Design – Work station – Graphics Terminal, Input devices – Sensor control devices, Digitizers, Key-board terminals – plotters and other output devices – central processing unit. Software configuration of a graphics system, Graphics packages.
4. NUMERICAL CONTROL:
   Basic components of NC system – NC part programming – APT language, CNC and DNC.
5. CAD/CAM
   Introduction, CAD and CAM, CAD/CAM process, CAD/CAM industrial applications.
6. COMPUTER CONTROL MANUFACTURING SYSTEMS:
   Computer requirements for process control, Hierarchical control, MAP – Future trends.
7. AUTOMATED FACTORY SYSTEMS:
   Flexibility and reconfigurability, flexible cells. Flexible Transfer lines, robot transfer line, CNC machine tool Transfer line, FMS, Hybrid systems. Application areas.
8. CIN, Computer control systems and its benefits, Group technology, Machining centres. Applications of robots in industry.

BOOKS FOR REFERENCE:

1. CAD/CAM: 1. Mikell P Groover and Wi Zimmers.
2. CAD concepts and applications. Donalds D. Voisinet.

METALLURGICAL ENGINEERING

IV- B.Tech.- I Semester **Credits – 4**

4 Periods/week Max. Marks – 80

SUPER ALLOYS

(ELECTIVE – II)

1. INTRODUCTION:

Introduction to super alloys, Guide to selection of super alloys, Wrought super alloys, Heat Resistant castings.

2. PHYSICAL METALLURGY:

Microstructure of wrought Heat-Resisting Alloys, Microstructure of Ni-base & Co-base heat-resistant casting alloys. Temperature and Time-dependent Transformation. Application to Heat Treatment of High Temperature Alloys. Relationship of properties to Microstructure in super alloys. Fracture properties of super alloys. High temperature corrosion and use of castings for protection.

3. PROCESSING:

Melting of Super alloys; Principles and practice of Vacuum Induction Melting and Vacuum Arc Remelting. Forming and Fabrication of super alloys; retor parts. Physical Metallurgy and Effects of process variables on the microstructure of wrought super alloys. Production of components by Hot-Isostatic pressing of Ni-base superalloy powders. Recent developments in P/M of super alloys. Casting critical components; Improving turbine blade performance by solidification control; The development of single crustal super alloy turbine blades; Quality of castings of super alloys; HIP improves castings; Heat Treating of Heat resistant alloys. Process and Metallurgical factors on joining superalloys and other high service temperature materials.

BOOKS

1. Super alloys: Source book; Mathew J. Donachie. Jr. editor: 1984
2. The super alloys: edited by Chester T. Sins and William C Haagel; 1972, A wiley-Inter Science publication, John Wiley & Sons New York.
3. Campbell IE High temperature Technology, John Wiley and Sons Inc.; 1956
4. High temperature Materials: Hehemann, F. and Ault GM John Wiley and Sons, Inc. London 1959.

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METALLURGICAL ENGINEERING

IV- B.Tech.- I Semester **Credits – 4**

4 Periods/week Max. Marks – 80

METALLURGICAL INSTRUMENTATION

(ELECTIVE – II)

UNIT – I:

1. HIGH TEMPERATURE INSTRUMENTATION:

a) Methods of obtaining high temperatures – resistance files calculation of wire size and length, oil metal and salt baths files for temperatures above 1000°C, Refractories for laboratory F/es other methods of heating.

b) Temperature measuring instruments like thermal expansion thermometers, thermocouples, pyrometric millivoltmeters, potentiometers, Resistance thermometers, Radiation Pyrometers.

c) Automatic control of temperature – control of F/e powder, position controllers, on-off control, proportion control Anticipating devices, proportional plus derivative control Temperature programming.

UNIT – II:

2. VACUUM INSTRUMENTATIONS:

a) Pumps and systems like Rotary mechanical pumps, Roots pump, Gaddee molecular pump, vapor pumps, getter-ion pumps, choice of pumps.

b) Measuring gauges for low pressures – Discharge tubes, Meleod gauge, Heat conductivity, manometers, ionization vacuum gauges. Beyard-Alpert gauge, leak detection.

UNIT – III:

3. INSTRUMENTATION FOR CALORIMETRY:

Instruments used for the measurement of enthalpy, specific heat, heat measurements, pulse method for specific heat, liquid metal solution calorimeter.

UNIT – IV:

4. ELECTRICAL INSTRUMENTATION

Measuring instruments – potentiometers, Bridges, DC voltmeters and Ammeters.

UNIT – V:

5. AUTOMATION IN MEASUREMENTS OF INTERNAL FRICTION AND ELASTIC MODULES:

Automatic counters for torsional pendulum, precise frequency measurement in torsional pendulum, Automatic measurement of Q^{-1} activation energy measurement, Measurement of concentration in solid solutions, studies of the viscous behaviour of grain boundaries.

METALLURGICAL ENGINEERING

IV- B.Tech.- I Semester **Credits – 4**

4 Periods/week Max. Marks – 80

NUCLEAR METALLURGY

UNIT – I:

ELEMENTARY NUCLEAR PHYSICS AND CHEMISTRY:

Structures of nucleous, radioactivity, bending energy: nuclear interaction; fission and fusion: nuclear reaction; energy, release and chain reactions; neutron cross-section; multiplication and criticality concepts and factors; mechanisms of moderation, radiation detection, radiation effects on fissile and nonfissile materials; radiation damage and radiation growth; thermal cycling; protection against radiations.

UNIT – II:

REACTOR COMPONENTS:

Types of reactors and classification.

MATERIALS FOR NUCLEAR REACTORS:

Considerations in selection and properties of common mateirals used as fuels, their physical and chemical properties; canning mateirals; coolants; control rods; reflectors and shielding mateirals.

UNIT – III:

PRODUCTION OF REACTOR MATERIALS:

Occurrence and general characteristics of nuclear minerals.

UNIT – IV:

INDIAN RESOURCES:

Flowsheets of processing of nuclear minerals for the production of nuclear grade uranium, thorium, beryllium and zirconium with empahsis on basic scientific principles involved; production and enriched uranium and fabrication of fuel elements.

UNIT – V:

Processing of irradiated fuel for recovery of Plutonium.

Nuclear power production and its economics.

BOOKS RECOMMENDED:

1. Wilkinson WD and Mrphy WF Nuclear Reactor Metallurgy Van Nostrand 1958
2. Wright JC Metallurgy in Nuclear Power Technology: Iliffe Book Ltd., 1962
3. Symposium on Rare matierals: Indian Institute of Metals.
4. Glasstone S and Snesonske A; Prncipales of Nuclear Reactor Engineering: Macmillan, London.
5. Grainger L Uranium and Thorium: George Newnes Ltd., London.
6. Gurinsky DH and Dienes JL Nulcears Fuels, Macmillan.
7. US Atomic Energy Commission, Reactor Hand book Material Mc. Graw Hill Book Co. 1955
8. Proceedings of the symposium on Nuclear Science and Engineering – Bhabha Atomic Research Centre, Bombay.

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METALLURGICAL ENGINEERING

IV- B.Tech.- I Semester **Credits – 4**

4 Periods/week Max. Marks – 80

POWDER METALLURGY

(ELECTIVE-II)

UNIT – I:

INTRODUCTION:

Emergence and importance of Powder Metallurgy: Comparison of Powder Metallurgy with other fabrication techniques, its scope and limitations.

UNIT – II:

CHARACTERISATION AND PRODUCTION OF POWDERS.

General characteristics of metal powders, particle shape flow rate, apparent density, specific surface area, particle size distribution: determination of powder characteristics; different methods of production of metal powders: Influence of manufacturing processes on powder characteristics.

UNIT – III:

CONSOLIDATION OF METAL POWDERS I: COMPACTION

Theory of Consolidation: Pressure transmission in powders;Compressibility and compactibility of powders; Green Strength; Hot isostatic pressing; Powder rolling.

UNIT – IV:

CONSOLIDATION OF METAL POWDERS II: SINTERING

Mechanisms of Sintering; Factors affecting sintering: Activated sintering: Liquid Phase sintering; sintering atmospheres: properties of sintered parts.

UNIT – V:

APPLICATIONS:

Porous parts:Self-lubricating bearings,filters: Dispersion strengthened materials: Cu-Al_2O_3, SAP; Electrical and Magnetic materials: Tungsten lamp filaments, electrical contacts, welding electrodes; Soft Magnetic materials (Fe,Fe-Ni); Permanent magnets(Alnico, $SmCo_5$), Cemented Carbides; Cermets.

BOOKS RECOMMENDED:

1. Introduction to Powder Metallurgy- J.S. Hirshhorn.
2. Treatise on Powder Metallurgy – C. Goetzel Vol-I & II
3. Powder Metallurgy Principles- F.V. Lenel
4. Powder Metallurgy- A.K. Sinha

METALLURGICAL ENGINEERING

IV- B.Tech.- I Semester **Credits – 4**

4 Periods/week Max. Marks – 80

ELECTRO METALLURGY & CORROSION LAB

LIST OF EXPERIMENTS:

1. Electroplating of copper on brass and to study the influence of current density on current efficiency.
2. Electroplating of Nickel using watt's bath and to study the influence of current density on current efficiency.
3. To anodise the given aluminium sample and to colour with a dye and to measure the thickness of the oxide film.
4. To determine the throwing power of electroplating bath.
5. Electroplating of chromium on mild steel and to study the influence of current density on current efficiency.
6. To understand the principles in galvanic cell corrosion using "Ferroxyl" indicating test solution.
7. To study the effect of inhibitors on corrosion of mild steel in an acidic solution.
8. To construct pourbiax diagrams using electro chemical/thermodynamic data.
9. To study the pitting corrosion of aluminium, stainless steel in suitable environments.
10. To conduct electropolishing of stainless steel using Nitric acid batch.
11. To conduct electroless plating of tin on glass.
12. To conduct elctroforming on hard plastics.

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METALLURGICAL ENGINEERING

IV- B.Tech.- I Semester **Credits – 4**

4 Periods/week Max. Marks – 80

MECHANICAL WORKING OF METALS LAB

LIST OF EXPERIMENTS:

1. Determination of forming limit diagram
2. To study the kinetics of static recrystallization in a cold worked metal.
3. To conduct rosette analysis to determine the stress components.
4. To grow single crystals by Strain annealing technique.
5. To very hall-petch relation in mild steel specimens.
6. To study the work hardening and strain rate sensitivity of a metal.
7. To study the effect of plastic anisotropy on the deformation behaviour.
8. To study the effect of rolling variables on the mechanical properties of metals.
9. To study the forging operations in the production of a hook.
10. To conduct the ring compression test to determine the friction coefficient.
11. To study the flow pattern in plasticine clay when extruded through a die.
12. To study defects produced in rolled and forged products.

METALLURGICAL ENGINEERING

IV- B.Tech.- II Semester **Credits – 4**

4 Periods/week **Max. Marks – 80**

ENVIRONMENTAL ENGINEERING

(ELECTIVE-III)

UNIT-I:

INTRODUCTION:

Waterborne Diseases-protected water supplier-population forecast, design period-water demand factors effecting- fluctuations- fire demand water quality & testing- drinking water standards.

Sources of water: Comparison from quality & quantity and other considerations-intakes-infiltration galleries distribution end systems-requirements –methods& layouts-design procedures-Hardy cross equivalent pipe methods-service reservoirs-storage capacity-pipe specials-joints, valves, air valves, scour valves and check valves-meters-laying and testing of pipe lines-pump house.

Unit-II:

Conservancy and water carriage systems:

Sewage and storm water estimation –time of concentration-storm water-overflows-combined flows- characteristics of sewage –cycles of decay-decomposition of sewage –examination of sewage-BOD-equations-COD.

Unit-III:

Design of Sewers:

Shapes of materials-Sewer appurtenances-manholes-inverted siphon-catch basins-flushing tanks-ejectors-pumps and pump houses-house drainage –components-requirements-sanitary fittings-traps-open pipe and two pipe systems of plumbing- ultimate disposal of sewage-sewage farming-dilution.

Unit-IV:

Layout and general outline of water treatment units:

Sedimentation-principles-design factors-coagulation-flocculation-clarifier design-coagulants-feeding arrangements.

Filteration:

Theory-working of slow and rapid gravity filters-multimedia filters-design of filters-troubles in operation-comparison of filters-disinfection-theory of chlorination-chlorine demand –other disinfection practices.

Unit:V

Layout and general outline outline of various units in a waste water treatment plant.

Primary treatment –design of screens-print chambers-skimming tanks-sedimentation tanks-principles of design-n-biological treatment –brickling filters-standard and high rate –construction and design of activated sludge treatment plant-principles and design of oxidation ponds.

METALLURGICAL ENGINERING

Sludge digestion:

Factors affecting-design of digestion tanks-sludge disposal by drying –septic tanks-working principles and design-soakpits.

Textbooks:

1.Water supply and Sanitary Engineering—GS Birdi

2.Water and Waste water Engineering—Foir Geyer and Okun

3.Water Engineering- Metoiaf and Eddy.

METALLURGICAL ENGINEERING

IV- B.Tech.- II Semester **Credits – 4**

4 Periods/week **Max. Marks – 80**

METALLURGICAL PROBLEMS

(ELECTIVE-III)

Problems based on the following topics:

Unit-I:

Stoichiometric calculations.

Burden calculations.

Unit-II:

Mass balance and Energy balance calculations.

Problems based on Principles of thermodynamics.

Unit-III:

Problems based on Kinetics of Metallurgical Processes.

Problems on Heat Transfer.

Unit-IV:

Problems on theoretical flame temperature.

Problems of pyro metallurgical problems.

Unit-V:

Problems based on Electro Metallurgical processes.

Problems of Hydro Metallurgical processes.

Books:

1. **Metallurgical problems-Butts**
2. **Non-Ferrous Extractive Metallurgy-Bray.**
3. **Elements of Heat Transfer.-Jakob & Hawkins.**

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METALLURGICAL ENGINEERING

IV- B.Tech.- II Semester **Credits – 4**

4 Periods/week Max. Marks – 80

LIGHT METALS AND ALLOYS

(ELECTIVE – III)

UNIT – I & II:

The extractionof Aluminium and Beryllium, properties of Al, and Be, properties of light metals, A1 wrought alloys, Al casting alloys uses of Al, Mg, Ti, Be, Ni.

UNIT – III:

Titanium and its alloy.

UNIT – IV:

Magnesium and its alloys

UNIT – V:

Heat treatment of Light Metal Alloys

BOOKS:

1. Materials in Industry – W.J. Patton.

METALLURGICAL ENGINEERING

IV- B.Tech.- II Semester **Credits – 4**

4 Periods/week Max. Marks – 80

SIMULATION AND DATA PROCESSING

(ELECTIVE-III)

Applications of Numerical methods to Metallurgical Engineering Problems:

Numerical Methods:

a) Roots of algebraic equations by Bisection method, False position method, Newton Raphson method, Secant method and quasi-Newton method.

b) Solution of simultaneous equations by Gauss elimination method , Gauss Jordan method, Dolittle(Grout's methods, Cholesky method).

c) Numerical Integration: Trapezoidal and Simpson's rule.

d) Least square curve fitting: Linear and Polynomial.

e) Interpolation, Extrapolation and Numerical differentiation ,Linear ,Newton and Lagrange methods.

f) Solution of ordinary differential equations- Rungakutta method,Euler's method.

Metallurgical Engineering Problems:

a) Heat and Mass calculations of chemical Reactions.

b) Heat Transfer

c) Physical Metallurgy and Heat Treatment.

d) Thermodynamics.

e) Gating and Risering.

f) Burden calculations.

g) Determination of crystal structure.

h) Sieve analysis.

i) Simulation of phase diagrams and blast furnace.

Reference:

1. Computer oriented Numerical Methods: Rajaraman(PHI Publications)
2. Computer Programming and Numerical Methods: S.Saran.
3. Numerical Methods in Engineering-Mario G.Salvadori & Meloin L.Baron(PHI publications)
4. Matrix operations on the computer –LL Bruid(LCUE publications)

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METALLURGICAL ENGINEERING

IV- B.Tech.- II Semester **Credits – 4**

4 Periods/week Max. Marks – 80

ALTERNATE SOURCES OF ENERGY

Unit-I:

Alternate sources of energy:

Introduction: Brief review of ocean thermal energy, tidal and wave energy, geothermal energy, Fuel cells, Nuclear energy, bio-mass and bio-gas. Scope of wind power generation in India, structure and measurement , Wind speed data and energy estimation, types of wind mills, Hydrogen energy concept ,production of hydrogen, storage of hydrogen , metal hydrates.

Unit-II & III:

Solar energy:

Structure of the sun, Basic sun-earth relationships, Celestial sphere-basic definitions, astronomical triangle, coordinate systems, determination of the sun's co ordinates, Solar radiation- the solar constant, extra terrestrial radiation, atmospheric attenuation, measurement and estimation, Bright sunshine hours, radiation on inclined surfaces. Solar energy devices- principle of operation-flat plate collector, water heater ,cooker, desalination, air heaters and solar ponds. Photo-voltaic conversion –solar cells, conversion efficiency-IV characteristics, enhancement of input by booster mirrors of different types, concentrating collectors, concentration ratio, acceptance angle, cylindrical ,parabolic concentrator, compound parabolic concentrator, orientation and energy absorption type(CPC collectors) to access tracking, polar access tracking, central photo voltaic power plants, central receiver power plants.

Unit-IV & V:

Energy Storage:

Significance of energy storage in solar energy process, types of energy storage-water storage ,packed bed storage, solar ponds, phase change energy storage , chemical energy storage, mechanical energy storage, storage of energy from wind mills, storage in electrical batteries, pumped hydro electrical storage

Text Books:

1. S.Rao && BB Parulekar," Energy Technology" Khan Publications, New Delhi-1995.
2. SP Sukhatme " Solar Energy –Thermal collection and storage" Tata Mc Graw Hill,New Delhi.

Ref.Books:

1. JA Duffie & WA Beckhman, " Solar Energy Engineering of Thermal Process", John Wiley, N.Y.1980
2. AAM Sayigh, "Solar Energy Engineering", Academic Press, N.Y.
3. T. Najat Vezerigulu, Editor, "Alternate Energy Sources-II", McGraw Hill N.Y.
4. Frank Kreith & JF Kreider, "Principles of Solar Energy Engineering" , McGraw Hill N.Y.
5. SS Pennal & L Icerman , Editors, "Energy", McGraw Hill N.Y.
6. Notes on Wind energy Systems, Short term course on Wind Energy Systems,organised By Indian Institute of Science, Bangalore.

METALLURGICAL ENGINEERING

IV- B.Tech.- II Semester | Credits – 4

4 Periods/week | Max. Marks – 80

TRANSPORT PHENOMENA IN METALLURGY

(ELECTIVE-IV)

1.MASS TRANSFER:

Fick's law, Diffusion ,Coefficients for gases, Gas diffusion- Equimolar counter diffusion of two gas components, Diffusion of one ideal gaseous component through a second stagnant ideal gas composed of ideal gas, liquid diffusion, diffusion in solids, diffusion in turbulent flow, similarity between heat and mass transfer for several engineering systems- fluids flowing in turbulent motion through pipes, gases flowing at right angles to cylinders, gases flowing parallel to flat plates, heat and mass transfer in free in free convention, humidification.

2. MOMENTUM TRANSFER:

Newton's law of viscosity, Non-Newtonian fluids, theory of viscosity of gases at low density, theory of viscosity of liquids, velocity distributions in laminar flow-shell momentum balances, flow of a falling film, flow through a circular tube.

The equations of change for isothermal systems-equation of continuity equation of motion , velocity distributions in turbulent flow-fluctuations and time-smoothed quantities, time-smoothing of the equations for change of an incompressible fluid.

Macroscopic balances for isothermal systems-Macroscopic mass balance, Macroscopic momentum balance.

Books:

1. Elements of Heat Transfer-M.Jakob and GA Hawkins.
2. Transport Phenomena.-RB Bird , WE Steward and ENLight foot.

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METALLURGICAL ENGINEERING

IV- B.Tech.- II Semester | Credits – 4

4 Periods/week | Max. Marks – 80

FERRO ALLOY TECHNOLOGY

(ELECTIVE – III)

1. INTRODUCTION:

Types of ferroalloys and their uses: present status of ferroalloy industry in India: Future plans and developments.

2. PRINCIPLES:

Physicochemical aspects of ferroalloys. Production by various methods.

3. EQUIPMENT:

Furnaces, types design, refractories, mechanical equipment, auxiliaries, electric power into heat: furnace power supply; working voltages; power factor and efficiency.

4.& 5 PRODUCTION:

Production of ferro-silico-calcium, ferromanmanganese (high and low carbon), ferro-chrome (high and low carbon), ferro-polybdenum ferro-tungstun, ferro-titanium, ferro-vanadium.

LAY OUT:

Lay out of a ferroalloy, plant and its production economics.

BOOKS RECOMMENDED:

1. Riss M. And Khodorovsky V, Production of Ferroalloys Mir Publishers, Moscow 1967
2. Symposium on Ferroalloys NML Technical J. Feb. 1962
3. World Ferrochrome producers: Met. Bull. Oct 30, 1962.
4. Andread FV Electrical Engineering Vol. 69 June, 1950
5. Elyntin VP Pavlov by A-Levin BE Alekseev EM Prof. Of Ferro Alloys, the State Scientific technical Prof. House, Moscow 1957

METALLURGICAL ENGINEERING

IV B.Tech.- I Semester **Credits – 4**

4 Periods/week Max. Marks – 80

EXPERIMENTAL TECHNIQUES IN METALLOGRAPHY

(ELECTIVE – III)

UNIT – I:

CHAPTER – I

Metallographic methods revealing structure polishing; Belief polishing; Sulfur prints; Chemicochemical polishing; Electro chemical polishing; Etching, Chemical etching, Electrolytic etching, Heat tinting, Ionic Bombardment Etching. Thermal Etching vacuum-Deposited Dielectric coatings; Etch pitting. Dislocation Etch pitting. Tests of correspondence between Etch pits and Dislocations. Optical Anisotropy produced by Etching. Surface markings; Taper sectioning; Reflectivity; polarized light, Metallurgical Applications. Optical properties.

UNIT – II & III:

CHAPTER – II

Optical Micorscopy. General Background – Light sources, Angular Aperture, Laws of perfection and Deflection, Numerical Aperture, Resolution, Depth of focus, aberrations of lences. Microscope components – objectives, Eyepieces, vertical illuminations, practical light sources. Optical methods of enhancing contrast-Dark field illumination, polarised light phase contrast Interference, Filters.

UNIT – IV & V:

CHAPTER – III

Electron Microscopy. General Backgrounds – Introduction; Electron wavelength, resolution, Dept of field and Depth of focus, fresnel fringes, Bright and Dark field, Selected area diffraction. Calibration, Stereoscopy, specimen preparation – Replica Methods; preparation of thin Foils from Bulk samples; Naturally thin samples, special transmission techniques, One sided thinning, Etched transmission samples, surface decoration technique.

TEXT BOOKS

1. Modern Metallographic Techniques & their application – victor phillips.
2. Physical Metallurgy, Part – I – RW Chao and P. Haasan
3. Smallman: Modern Metallography & Ashby
4. G. Thomas: Electron Microscopy of thin cystals.

REF. BOOKS:

Experimental Techniques in Physical Metallurgy – VT Cherepin and AK Mallik.

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METALLURGICAL ENGINEERING

IV B.Tech. –II Semester **Credits – 4**

4 Periods/week Max. Marks – 80

OPERATIONS RESEARCH

(ELECTIVE-IV)

Unit-I:

Development- Definition –Characteristics and Phases-Scientific method –Types of models-General methods for solving operation Research models.

Allocation: Linear Programming .Problem Formulation –Graphical Solution-Simplex method – Artificial variable technique-Quality principle.

Unit-II:

Transportation Problem-Formulation-Optimal Solution unbalanced transportation problem-Degeneracy, Assignment problem-Formulation optimal solution –Variations i.e non-square matrix(m x n)

Sequencing: Introduction –optimal solution for processing 'n' jobs through two machines and 'n' jobs through three machines- processing two jobs through 'm' machines-travelling salesman problem i.e. shortest cyclic route, models.

Unit-III:

Replacement:

Introduction-Replacement of items that deteriorate with time-when money value is not counted and counter- replacement of items that fall completely i.e group replacement.

Theory of games:

Introduction:-Minimax (Maximin) Criterion and optimal strategy-solution of games with saddle points –rectangular games without saddle point.

Unit-IV:

Waiting Lines: Introduction-Single channel-Poisson arrivals-,exponential service times, unrestricted queue, with infinite population and finite population models, single channel

Poisson arrivals-,exponential service times with infinite population and restricted queue-Multi channel poisson arrivals, exponential service times with infinite population and unrestricted queue.

Unit-V:

Inventory:

Introduction-Single item- deterministic models. Production is instantaneous or at a constant rate shortage and allowed or not allowed and withdrawals from stock is continuous- purchase inventory models with one price break, and multiple price breaks, shortages are not allowed-Stochastic models demand may be discrete variable or continuous variable-instantaneous production, instantaneous demand and no set up cost.

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METALLURGICAL ENGINEERING

Dynamic Programming:

Introduction-Bellmaw's Principle of optimality-solution of problems with finite number of stages.

Text books:

1.Operations Research: Methods and Problems by Maurice Casioni, Arthur Y&spin Lawrence Friedman.

2. Operations Research by Taha.

3.Operations Research by Wagner.