West Bengal University of Technology

BF-142, Salt Lake City, Kolkata-700064

Syllabus of First Year

(Common to All Branches of B.Tech Programme)

upto 2006

A. THEORY

SL. NO.	CODE	THEORY	CONTACTS (PERIODS/WEEK)				CREDITS
			L	T	P	TOTAL	
1	Hu 101	English Language & Communication	2	1		3	3
2	Ph 101	Engineering Physics	3	1		4	4
3	M 101	Mathematics	3	1		4	4
4	ME 101	Mechanical Sciences	3	1		4	4
5	EE 101	Basic Electrical Engineering	3	1		4	4
6	Ch 101	Environment & Ecology	3			3	3
Total of Theory						**22**	**22**
B. PRACTICALS							
7	Ph 191	Engineering Physics Lab			3	3	2
8	EE 191	Electrical Engineering Lab			3	3	2
9	ME 191	Engineering Graphics			3	3	2
10	ME 192	Workshop Practical			3	3	2
Total of Practical						**12**	**8**
Total of Semester			**34**				**30**

FIRST YEAR SECOND SEMESTER

A. THEORY

SL. NO.	CODE	THEORY	CONTACTS (PERIODS/WEEK)				CREDITS
			L	T	P	TOTAL	
1	Ph 201	Engineering Physics	4			4	4
2	M 201	Mathematics	3	1		4	4
3	ME 201	Mechanical Sciences	3			3	3
4	CS 201	Introduction to Computing	2	1		3	3
5	EC 201	Basic Electronics Engg.	3	1		4	4
6	Ch 201	Engineering Chemistry	3			3	3
Total of Theory						**21**	**21**
B. PRACTICALS							
7	Ph 291	Engineering Physics Lab			3	3/ 2	1

					2		
8	Ch 291	Engineering Chemistry Lab			3 — 2	3/ 2	1
9	CS 291	Computing Lab			3	3	2
10	EC 291	Electronics Engineering Lab			3	3	2
11	ME 291	Engineering Graphics			3	3	2
12	ME 292	Workshop Practical			3	3	2
	Total of Practical					**15**	**10**
Total of Semester			**36**				**31**

DETAILS OF CURRICULUM

ENGLISH LANGUAGE & COMMUNICATION

Code : Hu 101 (First Semester)
Contact : 2L + I T = 3
Credits: 3

Guidelines for Course Execution

Objective of the Course
To impart basic skills of communication in English through intensive practice to the first year UG students of Engineering so as to enable them to function confidently and effectively in that language in the professional sphere of their life.
Desired Entry Behaviour
The student must have some basic command of English that is must be able to :

1. Write reasonably grammatically
2. Understand (if not use) at least some 2500 general purpose words of English to express himself in writing and 1500 words to talk about day-to-day events and experiences of life.
3. Understand slowly-delivered spoken material in Standard Indian English , and
4. Speak reasonably clearly (if not fluently) on routine matters with his fellow students.

Strategies for Course Execution

- The topics must be conveyed through plenty of examples. Lecture classes must be conducted as lecture-cum-tutorial classes.
- It is a course that aims to develop skills. It is therefore “practical” in orientation. Plenty of exercises of various kinds must be done by the students both inside and outside the classroom.
- The teacher must not depend on a single or a set of two or three text books. He must choose his materials from diverse sources.
- Keeping in view the requirements of his students , the teacher may have to prepare some teaching and exercise material.
- For practice in listening , good tape recorders can be used if the more advanced facilities (for example , language laboratory) are not available. In fact they can be used very fruitfully.
- The teacher must function as a creative monitor in the class-room.
- Minimum time should be spent in teaching phonetic symbols , stress , intonation , etc. The aim should be to enable the students to find out for himself the correct pronunciation of a word from a learner’s dictionary. In teaching speaking, emphasis should be on clarity , intelligibility and reasonable fluency rather than on “ correct “ pronunciation of words. Classroom presentation and group discussion sessions should be used to teach speaking.

End Results from the Course
Some Key Concepts

Communication as sharing; context of communication; the speaker / writer and the listener / reader; medium of communication; barriers to communication; brevity, clarity and appropriateness in communication.

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Writing

Selecting material for expository, descriptive , and argumentative pieces, business letters; formal report; summarizing and abstracting ; expressing ideas within a restricted word limit; paragraph division; the introduction and the conclusion; listing reference material; use of charts, graphs and tables ; punctuation and spelling; semantics of connectives, modifiers and modals; variety in sentences and paragraphs.

Reading Comprehension

Reading at various speeds (slow , fast , very fast) ; reading different kinds of texts for different purposes (for example , for relaxation , for information , for discussion at a later stage , etc.) ; reading between the lines.

Speaking

Achieving desired clarity and fluency ; manipulating paralinguistic features of speaking (voice quality , pitch , tone , etc.) pausing for effectiveness while speaking ; task-oriented , interpersonal , informal and semiformal speaking ; task-oriented, interpersonal , informal and semiformal speaking; making a short , classroom presentation.

Group Discussion

Use of persuasive strategies including some rhetorical devices (for emphasizing , for instance; being polite and firm; handling questions and taking in criticism of self; turn-taking strategies and effective intervention ; use of body language.

Telephonic Conversation.

Listening Comprehension

Achieving ability to comprehend material delivered at relatively fast speed; comprehending spoken material in Standard Indian English, British English and American English ; intelligent listening in institutions such as an interview in which one is a candidate.

Syllabus Details:

Grammar – Correction of sentence, Vocabulory / word formation, Single word for a group of words, Fill in the blank, transformation of sentences, Structure of sentences – Active / Passive Voice – Direct / Indirect Narration (5 lectures)

Essay – Descriptive – Comparative – Argumentative – Thesis statement- Structure of opening / concluding paragraphs – Body of the essay (7 lectures)

Reading Comprehension – Global – Contextual – Inferential – Select passages from recommended text (8 lectures)

Business Correspondence – Letter Writing – Formal. Drafting. Biodata- Resume′- Curriculum Vitae (7 lectures)

Report Writing – Structure , Types of report – Practice Writing (8 lectures)

Communication / Public Speaking skills , Features of effective speech, verbal-nonverbal (7 lectures)

Group discussion – principle – practice (6 lectures)

Distribution of marks:

Examination

Letters including official	10
Precis	10
Comprehension (chart / graph)	10
Report writing including technical/scientific	10
Essay	10
Grammar	20
	70

Assessment

Class tests	10
Unit Tests	
Reading ability	5
Speaking ability	5
Group Discussion	5
Formal conversation	5
	30

References / Books:

1. Mark MaCormack : "Communication"
2. John Metchell " How to write reports"
3. S R Inthira & V Saraswathi " Enrich your English – a) Communication skills b) Academic skills " Publisher CIEFL & OUP
4. R.C. Sharma and K.Mohan , "Business Correspondence and Report Writing " , Tata McGraw Hill , New Delhi , 1994
5. L.Gartside , "Model Business Letters" , Pitman , London , 1992
6. Longman , "Longman Dictionary of Contemporary English" (or 'Oxford Advanced Learner's Dictionary of Current English' , OUP , 1998.
7. Maxwell Nurnberg and Rosenblum Morris , "All About Words" , General Book Depot, New Delhi , 1995
8. A Text Book for English foe Engineers & Technologists
9. Written Communication in English by Sara-Freeman – Orient Longman
10. English skills for Technical Students by British Council
11. The Young Writer's TheraurusS by A.J.Koutsoukis – Orient Longman
12. Communicating at Work by Alder & Elmhorst – McGraw-Hills International
13. Succeeding Through Communication – Subhash Jagota, EXCEL BOOKS
14. Art of Effective Communication – Charles J Margerison, EXCEL BOOKS
15. Communication Skill For Effective Management – A.Ghanekar.EPH
16. Communication Skill – L.M.Shaikh.EPH
17. Communication Skill for Technical Students – Faratullah, Orient Longman
18. English Skills for Technical Students – Orient Longman
19. English Online – Jayasree Mohan Raj, Orient Longman
20. Spoken English – R.K.Bansal, Orient Longman
21. English for Engineers & Technologists Vol.1 & 2 – Orient Longman
22. Speak English (with Audio Cassettes Vol.1 – Vol.8) – Don Dallas,Orient Longman

Code: PH-101**(First Semester)**
Contacts: 4L
Credit: 4

Module 1: Classical Mechanics

Newtonian Mechanics – difficulties to handle coupled equations, Constraints (both time dependent and time independent), Degrees of freedom, Generalised co-ordinates, Generalized force, potential and kinetic energy, Lagrange's equation of motion and Lagrangian, Ignorable co-ordinates, Hamilton's equation and Hamiltonian. *The course should be discussed along with physical problems of 1-D motion*).

6L

Module 2: Field Theory

2.1 Basic concepts of Vector, Scalar and Vector products, Areal vector, Concepts of field (Scalar and Vector fields, examples), Scalar and Vector point functions related to the field, Derivative of vector, directional Derivative of vector point function, Gradient of scalar field, Line integral, Potential energy and force.

5L

2.2 Vector field, Velocity field and flux, Divergence of vector field, Electrostatic field, its potential and flux, Divergence of electrostatic field, Gauss' Law of Electrostatics, Gauss's divergence theorem (*No proof*), Laplace's equation, Poisson's equation, (*Application to Cartesian, Spherically and Cylindrically symmetric systems*), Continuity equation.

5L

2.3 Curl of a vector field, Stoke's theorem (*No proof*), Potential field, Curl of velocity field, Curl of magnetic field and Ampere's Circuital law, its application in simple cases, Curl of electric field and divergence of magnetic field and the concepts of scalar and vector potentials.

5L

2.4 Faraday's law of electro-magnetic induction, Maxwell's field equations, Concept of displacement current, Maxwell's wave equation and its solution for free space.

4L

Module 3: Vibration and waves

3.1 Simple harmonic motion - its expression and differential equation, Superposition of two linear SHMs (*with same frequency*), Lissajous' figures.
Damped vibration – differential equation and its solution, Critical damping, Logarithmic decrement, Analogy with electric circuits.
Forced vibration – differential equation, Amplitude and Velocity resonance, Sharpness of resonance and Quality factor.
Progressive wave equation and its differential form, Difference between elastic (mechanical) and electromagnetic waves.

8L

3.2 General concept of Polarisation, Plane of vibration and plane of polarization, Malus's law, Qualitative discussion on Plane, Circularly and Elliptically polarized light, Polarisation through reflection and Brewster's law, Double refraction (birefringence) - Ordinary and Extra-ordinary rays, Polaroid, Nicol prism, Retardation plates and analysis of polarized lights.

6L

3.3 Huygen's construction of wave surface and wave fronts, Interference of electromagnetic waves, Spatial and Temporal Coherence, Conditions for sustained interference, Conservation of energy and intensity distribution, Interference through division of wave front – Theory and application of Fresnel's Bi-prism experiment, Interference through division of amplitude – Thin film interference, Fringes of equal thickness and equal inclination, Theory and application of Newton's ring experiment.

8L

3.4 Diffraction of light – Fresnel and Fraunhofer class, Theory of Fraunhofer diffraction for single slit and double slits, Intensity distribution, Extension to N-slits and plane transmission grating, Missing orders and Resolving power of grating.

6L

Code: PH-191**(First Semester)**
Contacts: 3P
Credit:2

1. Determination of Young's modulus by Flexure method and calculation of bending moment and shear force at a point on the beam.
2. Determination of modulus of rigidity by static/ dynamic method.
3. Determination of thermal conductivity of a good conductor by Searle's mothod.
4. Determination of thermal conductivity of a bad conductor by Lees and Chorlton's method.
5. Determination of dielectric constant of a given dielectric material.
6. Use of Carry Foster's bridge to determine unknown resistance.
7. Determination of resistance of ballistic galvanometer by half deflection method and study of variation of logarithmic decrement with series resistance.
8. Determination of wavelength of light by Newton's ring method.
9. Determination of wavelength of light by Fresnel's bi-prism method.
10. Determination of wavelength of light by Laser diffraction method.
11. Determination of dispersive power of the material of given prism.
12. Determination of co-efficient of viscosity by Poiseulle's capillary flow method.
13. Analysis of polarized light by polarizing sheet, half and quarter wave plates.

It is resolved that at least 7 experiments has to be performed by a student.

Code: PH-291(Second Semester)
Contacts: (2P)
Credit: (2)

1. Determination of specific charge (e/m) of electron by J.J. Thomson's method.
2. Determination of Planck's constant using photocell.
3. Determination of Hall co-efficient of semiconductors.
4. Determination of band gap of semiconductors.

5. Determination of Rydberg constant by studying Hydrogen/ Helium spectrum.
6. Determination of Lande'g factor using Electron spin resonance spetrometer.
7. Determination of the thermo-electric power at a certain temperature of the given thermocouple.
8. To study current-voltage characteristics, load response, areal characteristics and spectral response of photovoltaic solar cells.
9. To study crystal symmetries of Bravais lattices with the help of models.
10. Determination of numerical aperture and the energy losses related to optical fibre experiment.
11. Determination of Stefan's radiation constant.
12. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.

It is resolved that at least 7 experiments has to be performed by a student.

Code: PH-201(Second Semester)
Contact: 4L
Credit: 4

Module 1: Special theory of Relativity
Frames of reference (inertial and non-inertial), Galilean transformation, Michelson-Morley experiment and the significance of the experimental results, Postulates of Einstein's special theory of relativity, Lorentz transformation, Length contraction, Time dilation, Velocity addition, Variation of mass with velocity, Mass energy equivalence.

10L

Module 2: Quantum Physics
2.1 Inadequacy of Classical Physics in explaining (i) Black body radiation (*Rayleigh Jeans' law, Wien's law, Ultraviolet catastrophy, Planck's radiation law*), (ii) Einstein's Photoelectric effect, (iii) Compton effect (*calculation of Compton wavelength is required*).

4L

2.2 Wave-particle duality and de Broglie's hypothesis, Concept of matter waves, Davisson-Germer experiment, Notion of wave packets and Heisenberg's uncertainty principle, γ-ray microscope experiment, applications.

5L

2.3 Formulation of quantum mechanics and Basic postulates, Schroedinger's equation (*both time dependent and time independent*), Operator correspondence, Physical interpretation of wave function ψ (*normalization and probability interpretation*), Expectation values, Application of Schroedinger equation – Particle in an infinite square well potential (*1-D and 3-D potential well*), Discussion on degenerate levels.

9L

Module 3: Quantum statistics
Concept of energy levels and energy states, Microstates, Macrostates and Thermodynamic probability, Equilibrium macrostate, Classical statistics (Maxwell-Boltzmann statistics) and its limitation, Fermi-Dirac statistics, Fermi distribution at zero & non-zero temperature, Calculation of Fermi level in metals, also total energy at absolute zero of temperature and total number of particles, Necessity of Bose-Einstein statistics, Comparison between three statistics.

7L

Module 4: Crystallography and Solid state physics
4.1 Elementary ideas of crystal structure - lattice, basis, unit cell, Fundamental types of lattices – Bravais lattice, Simple cubic, f.c.c. and b.c.c. lattices, Miller indices and miller planes, Co-ordination number and Atomic packing factor.

6L

4.2 X-rays – Origin of Characteristic and Continuous X-ray, Bragg's law (*simple derivation*), Determination of lattice constant. Elementary idea of crystal bands and to differentiate between metal, insulator and semiconductor based on energy band diagram.

4L

Module 5: Laser and Fibre optics
Spontaneous and Stimulated emission of radiation, Population inversion, Einstein's A & B co-efficient, Optical resonator and Condition necessary for active Laser action, He-Ne Laser.
Optical Fibres – Core and cladding, total internal reflection, Calculation of Numerical aperture and acceptance angle, applications.

5L

Module 6: Nuclear Physics
Properties of nucleus – Nuclear mass, charge, size, Binding energy, Packing fraction, Explanation of binding energy curve, Nature and characteristics of nuclear force (*elementary discussion*).
Conservation principles in nuclear reaction and calculation of Q-value and threshold energy, Elementary idea of nuclear fission, fusion and chain reaction.

Reference Books
PH-101

Module 1: Classical Mechanics
1. J. Goldstein

2. A.K. Roychaudhuri
3. R.G. Takwal and P.S. Puranik
4. Rana and Joag
5. M. Speigel (Schaum Series)
6. J.C. Upadhya (Mechanics)

Module 2: Field Theory
1. Reitz, Milford and Christy
2. David J. Griffith
3. D. Chattopadhyay and P.C. Rakshit
4. Shadowitz (The Electromagnetic Field)

Module 3: Vibration and Waves
1. Kingsler and Frey
2. D.P. Roychaudhury
3. N.K. Bajaj (Waves and Oscillations)
4. K. Bhattacharya
5. R.P. Singh (Physics of Oscillations and Waves)
6. A.B. Gupta (College Physics Vol.II)
7. Chattopadhya and Rakshit (Vibration, Waves and Acoustics)

Module 4: Optics
1. Möler (Physical Optics)
2. A.K. Ghatak
3. E. Hecht (Optics)
4. E. Hecht (Schaum Series)
5. F.A. Jenkins and H.E. White

PH-201

Module 1: Special Theory of Relativity
1. H.P. French
2. R. Resnick
3. J.C. Upadhya (Mechanics)

Module 2: Quantum Physics
1. Eisberg and Resnick
2. Arthur Baiser (Perspective & Concept of Modern Physics)
3. A.K. Ghatak and S. Lokenathan
4. S.N. Ghoshal (Introductory Quantum Mechanics)
5. Mani and Mheta (Modern Physics)
6. E.E. Anderson (Modern Physics)
7. Haliday, Resnick and Crane (Physics vol.III)

Module 3: Quantum Statistics
1. Sears and Sallinger (Kinetic Theory, Thermodynamics and Statistical Thermodynamics)
2. Mondal (Statistical Physics)
3. S.N. Ghoshal (Atomic and Nuclear Physics)
4. Singh and Singh
5. B.B. Laud (Statistical Mechanics)

Module 4: Crystallography and Solid state physics
1. S.O. Pillai (a. Solid state physics b. Problem in Solid state physics)
2. A.J. Dekker
3. Aschroft and Mermin
4. Ali Omar
5. R.L. Singhal
6. Jak Tareen and Trn Kutty (Basic course in Crystallography)

Module 5: Laser and Fibre Optics
1. A.K. Ghatak and Thyagarajan (Laser)
2. Tarasov (Laser)
3. P.K. Chakraborty (Optics)
4. B. Ghosh and K.G. Majumder (Optics)

5. B.B. Laud (Laser and Non-linear Optics)

Module 6: Nuclear Physics
1. A.B. Gupta and D. Ghosh (Atomic and Nuclear Physics)
2. S.N. Ghoshal (Nuclear Physics)
3. J.B. Rajam (Atomic and Nuclear Physics)
4. I. Kaplan

BASIC ELECTRICAL ENGINEERING

Code: EE 101(First Semester)
Contacts: 3L + 1T = 4
Credits: 4

Coulomb's law, Gauss's theorem (proof), capacitance calculation for plates, concentric spheres and co-axial cylinders, dielectrics, stored energy, electrostatic precipitator, electrostatic photocopying (Xerox).
6L

Ohm's law, Kirchhoff's laws, mesh current and node voltage methods, Delta-star and star-Delta conversion, superposition theorem; Thevenin's and Norton's theorems (with independent sources), Maximum power transfer theorem (with proof) 5L

Magnetism as a Relativistic effect; Biot-savart law, Ampere's circuital law, magnetic field due to long straight conductors, coils and solenoids; magnetic forces : Lorentz /Ampere force, force production in simple systems (as in PMMC)
5(4) L

B-H characteristics of ferromagnetic materials, Magnetic circuits, Faraday's law, self and mutual inductance, Energy stored in a magnetic field, lifting power of electromagnet, Hysteresis and Eddy current losses.
3L

D.C. Machines: Construction , Characteristics of D.C.generators and D.C. motors(qualitative and only for shunt & series machines), starting (by 3-point starter) and speed control of D.C. machines (armature voltage and field current control)
5(4) L

D.C. transients in R-L, R-C and R-L-C circuits 3(2) L

A.C. generation ,waveforms, average and RMS values, peak-factor, R-L, R-C and R-L-C circuits, symbolic notations, j-operator, complex representation of impedances, power factor, active and reactive power, series, parallel and series parallel circuits, series and parallel resonance, Q-factor ; application of circuit theorems.Maximum power transfer theorem in A.C. circuits.
7(6) L

Three phase power supplies, Delta and star connection, line and phase quantities, solution of 3-phase circuits for balanced voltage and balanced loads, phasor diagrams, 3 phase, 4 wire circuits, power measurement by two wattmeter method. General structure of electrical power systems, Power transmission & distribution through overhead lines & underground cables.(single line diagram only)
5L

Single phase Transformers **:** Core and shell type construction, EMF equation, no load and on load operation, open and short circuit tests, equivalent circuit, regulation and efficiency calculations.
3L

3 Phase Induction Motors: Construction, Production of rotating field, principle of operation ratings. Torque –speed characteristics (qualitative only).Starters for squirrel cage and wound rotor Induction motors. Speed Control (only voltage control and frequency control)

References / books:

1. Nagrath I J – "Basic Electrical Engineering" Tata McGraw Hill Pub. Co.
2. Kamaleshaiah and Naidu – "Introduction to Electrical Engineering" Tata McGraw Hill Pub. Co 1995.
3. Edward Hughes (revised by Ian McKenzie Smith) , "Electrical Technology " , Seventh Ed. , English Language Book Society Publication with Longman , 1995.
4. Vincent Del Torro , "Electrical Engineering Technology " , Second Edition, Prentice Hall of India Pvt. Ltd. , 1994
5. Principles and Applications Of Electrical Engineering by Rizzoni TMH

6. H.Cotton , "Advanced Electrical Technology " , Issac Pitman , London
7. Theodore Wildi, "Electrical Machines, Drives and Power Systems", Second Ed. , Prentice Hall, 1996.
8. J.R. Cogdell , " Foundations of Electrical Engineering " , Second Ed. , Prentice Hall, 1996
9. Cotton H – "Electrical Technology"- Wheeler, 1989.
10. Parker Smith S – Problems in Electrical Engineering , CBS, 9th Edn, '81
11. JR Cogdell, Foundations of Electrical Engineering . PHI
12. McGraw Hill Encyclopedai of Science & Technology , Vol.6 & 13
13. Theory And Problems Of Elements Of Electrical Engineering – Vaidya,Bhagwat, EPH.
14. Basic Electrical Science and Technology- Murgesh Kumar, Vikas
15. Experiments in Basic Electrical Engg – Bhattacharya S.K., New Age International
16. Fundamentals of Electrical Machines – Gupta B.R., New Age International
17. Engineering Basics – Thyagarajan T., New Age International
18. Electrical Machine Design Data Book – Shanmugasundaram A., New Age Inter.

ENVIRONMENT & ECOLOGY

Code: Ch 101(First Semester)
Contacts: 3L = 3
Credits: 3

General

Basic ideas of environment, basic concepts related to environmental perspective, man, society and environment, their inter relationship. 1L

Mathematics of population growth and associated problems, definition of resource, types of resource, renewable, nonrenewable, potentially renewable, effect of excessive use vis-à-vis population growth, definition of pollutant and contaminant. Environmental impact assessment. 2L

Environmental degradation:

Acid rain, toxic element, particulates, noise pollution , air pollution and its effect on man. 1L

Overall methods for pollution prevention, environmental problems and sustainable development , components of environment 1L

Ecology

Elements of Ecology :

System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem, biotic and abiotic components.

Ecological balance and consequence of change:

Effect of abiotic factor on population, flow chart of different cycles with only elementary reaction [oxygen, nitrogen, phosphate, sulphur], food chain [definition and one example of each food chain] 3L

Air Pollution and Control

Atmospheric Composition: Troposphere, stratosphere, mesosphere, thermosphere, tropopause, stratopause and mesopause 1L

Energy Balance:

Conductive and convective heat transfer, radiation heat transfer, simple global temperature modal [Earth as a black body, earth albedo]), problems. 3L

Green-house effects:

Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. 1L

Climate , weather:

Difference between climate and weather

Global warming and its consequence: 2L

Adiabatic lapse rate, atmospheric stability, temperature inversion, radiation inversion

Atmospheric dispersion:

Maximum mixing depth, ventilation coefficient, smokestack plumes and atmospheric lapse rate. 1L

The point-source Gaussian plume model excluded.

Source and effect of pollutants:

Toxic chemicals in the environment , toxic chemicals in air , suspended particulate matter, carbon dioxide, sulphur dioxide, nitric oxide, lead, carbon monoxide. 2L

Primary and secondary pollutants:

Emission standard, criteria pollutant, oxides of carbon, oxide of nitrogen, oxide of sulphur, particulate, PAN

Depletion Ozone layer:

CFC, destruction of ozone lair by CFC, impact of other greenhouse gases, effect of ozone modification. 1L

Standards and control measures:

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Industrial, commercial and residential air quality air quality standard, Control measure (ESP, Cyclone separator, bag house, catalytic converter, scrubber (ventury). Statement with brief reference) 1L

Water Pollution and Control

Hydrosphere:

Hydrological cycle 1L

Natural water

Pollutants : their origin and effects :

Oxygen demanding wastes, pathogens, nutrients, salts, thermal application, heavy metals, pesticides, volatile organic compounds 1L

River / lake / ground water pollution

River

DO, 5day BOD test, BOD reaction rate constants, temperature dependents of BOD, effect of oxygen demanding wastes on river [Deoxygenation, reaeration], COD , Oil, Grease, pH. 2L

Lake

Eutrophication [Definition, source and effect] 1L

Ground Water:

Aquifers, hydraulic gradient, ground water flow. (Definition only) 1L

Standard and control:

Waste water standard [BOD,COD,Oil, Grease], Water treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening], wastewater treatment, primary treatment , secondary treatmens [Trickling filters, rotating biological contractor, activated sludge, sludge treatment, oxidation ponds], tertiary treatment definition. 3L

Arsenic pollution :

Biochemical effect, contamination, speciation 2L

Land Pollution

Lithosphere

Composition

Pollutants

Municipal, industrial, commercial, agricultural, hazardous solid wastes 1L

Recovery and conversion method 2L

Waste and waste management

Land filling, incineration, composting

Noise Pollution **2L**

Cources, effects

Definition of noise, effect of noise pollution , noise classification, transport noise, occupational noise, neighbourhood noise, definition of noise intensity, noise threshold limit value.

References / Books:

1. Masters , G.M., “Introduction to Environmental Engineering and Science”, Prentice –Hall of India Pvt. Ltd. , 1991
2. Basak: Environmental Engineering TMH
3. Nebel , B.J., “Environmental Science”, Prentice –Hall Inc., 1987
4. Odum , E.P., “Ecology: The Link between the natural and social sciences” , IBH Publishing Com. , Delhi
5. Dash: Fundamentals Of Ecology TMH
6. Environmental Management – N.K. Uberoi, EXCEL BOOKS
7. Fundamentals of environmental studies by D.K.Sinha, & A.D.Mukherjee
8. Introduction to Environmental Engineering Sc. by G.Mmasters
9. Environmental Chemistry by A.K.De, New Age International
10. Environmental Management- Mukherjee, Vikas
11. Environmental Management- Pandey, Vikas
12. Environmental Chemistry – Sindhu P.S., New Age International
13. Water Pollution & Management – Varshney C.K., New Age International
14. Water Chemistry – Venkateswarlu K.S., New Age International
15. Water Pollution: Causes, Effects & Control – Goel P.K., New Age International
16. Environmental Pollution Control Engg – Rao C.S., New Age International
17. Land Treatment of Waste Water – Gohil M.P., New Age International

BASIC ELECTRICAL ENGINEERING LABORATORY

Code: EE 191 (First Semester)
Contacts: 3 P
Credits: 2
Suggested List of Experiments

1. To measure the armature and field resistance of a DC machine.
2. To calibrate a test (moving iron) ammeter and a (dynamometer) wattmeter with respect to standard (DC PMMC) ammeter and voltmeters.
3. Verification of circuit theorems , Thevenin's and Superposition theorems (with DC sources only).
4. Voltage-current characteristics of incandescent lamps and fusing time-current characteristics of fuse wire.
5. Measurement of current, voltages and power in R-L-C series circuit excited by (single phase) AC supply.
6. Open circuit and short circuit tests on a single phase transformer.
7. Connection and starting of a three phase induction motor using direct on line (DOL) , or star delta starter.
8. Connection and measurement of power consumption of a fluorescent lamp.
9. Determination of open circuit characteristics (OCC) of a DC machine.
10. Starting and speed control of a DC shunt motor.
11. Connection and testing of a single phase energy meter (unity power factor load only)
12. Two wattmeter method of measuring power in three phase circuit (resistive load only)
13. Measurement of thermo emf between different types of thermocouples as a function of temperature difference between the junction , measurement of an unknown temperature.
14. Design and use of potentiometer
15. Study of LCR circuits with AC current.

INTRODUCTION TO COMPUTING

Code : CS 201(First Semester)
Contacts : 2L + 1T = 3
Credits : 3

Fundamentals of Computer:
History of Computer, Generation of Computer, Classification of Computers 2L

Basic Anatomy of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices 3L

Binary & Allied number systems representation of signed and unsigned numbers. BCD, ASII. Binary Arithmetic & logic gates 6L

Assembly language, high level language, compiler and assembler (basic concepts) 2L

Basic concepts of operating systems like MS DOS, MS WINDOW, UNIX, Algorithm & flow chart 2L

C Fundamentals:
The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements 3L

Operators & Expressions:
Arithmetic operators, relational and logical operators, type, conversion, increment and decrement operators, bit wise operators, assignment operators and expressions, precedence and order of evaluation. Input and Output: Standard input and output, formatted output -- printf, formatted input scanf. 5L

Flow of Control:
Statement and blocks, if - else, switch, loops - while, for do while, break and continue, go to and labels 2L

Fundamentals and Program Structures:
Basic of functions, function types, functions returning values, functions not returning values, auto, external, static and register

variables, scope rules, recursion, function prototypes, C preprocessor, command line arguments.

6L

Arrays and Pointers:
One dimensional arrays, pointers and functions, multidimensional arrays. 6L

Structures Union and Files:
Basic of structures, structures and functions, arrays of structures, bit fields, formatted and unformatted files.

5L

Recommended reference Books:

Kerninghan, B.W.	The Elements of Programming Style
Yourdon, E.	Techniques of Program Structures and Design
Schied F.S.	Theory and Problems of Computers and Programming
Gottfried	Programming with C Schaum
Kerninghan B.W. & Ritchie D.M.	The C Programming Language
Rajaraman V.	Fundamental of Computers
Balaguruswamy	Programming in C
Kanetkar Y.	Let us C
M.M.Oka	Computer Fundamentals,EPH
Leon	Introduction to Computers,Vikas
Leon-	Fundamental of Information Technology,Vikas
Ram B.	Computer Fundamentals, New Age International
Ravichandran D.	Programming in C, New Age International
Xavier C.	C Language & Numerical Methods, New Age Inter.
Xavier C.	Introduction to Computers, New Age International
Rao S.B.	Numerical Methods with Programs in Basic Fortran Pascal & C++, Universities Press
Dutta N.	Computer Programming & Numerical Analysis, Universities Press
Bhanu Pratap	Computer Fundamentals
Rajaram	Computer Concepts & C Program, Scitech

BASIC ELECTRONICS ENGINEERING

Code : EC 201(Second Semester)
Contacts : 3L + 1T = 4
Credits : 4
Introduction:
Crystalline material: mechanical properties, energy band theory, Fermi levels 2L

Conductors, Semiconductors and Insulators: electrical properties, band diagrams. Semiconductors: intrinsic and extrinsic, energy band diagram, electrical conduction phenomenon, P-type and N-type semiconductors, drift and diffusion carriers, mass action law and continuity equation (statement only)

6L

Formation of P-N junction, energy band diagram, built-in-potential forward and reverse biased P-N junction, formation of depletion zone, V-I characteristics, Zener breakdown, Avalanche breakdown and its reverse characteristics, junction capacitance and varactor diode.

6L

Simple diode circuits, load line, linear piecewise model; rectifiers: half wave, full wave, its PIV, DC voltage and current, ripple factor, efficiency Clipper and Clamper circuits

5L

Introduction to Transistors:
Formation of PNP / NPN junctions, energy band diagram; transistor mechanism and principle of transistors, CE, CB, CC configuration, Ebers-Moll model of transistor; transistor characteristics: cut-off active and saturation mode, early effect.

4L

Biasing and Bias stability: calculation of stability factor with variation of Ico Different operating modes; CE, CB, CC and their properties; small signal low frequency operation of transistors; equivalent circuits h parameters as a two port network.

4L

Transistors as amplifier: expression of voltage gain, current gain, input impedance and output impedance, frequency response for CE amplifier with and without source impedance (qualitative)

4L

Introduction to Field Effect Transistor:
Construction and characteristics of JFET (N channel only), Transfer characteristics; construction and characteristics of MOSFET (N channel only), depletion and enhancement type; CS, CG, CD configuration

5L

Feed Back Amplifier:
Concept (Block diagram), properties, positive and negative feed back, loop gain, open loop gain, feed back factors; topologies of feed back amplifier; effect of feed back on gain, output impedance, input impedance, sensitivities (qualitative), bandwidth stability; effect of positive feed back: instability and oscillation, condition of oscillation, Barkhausion criteria.

5L

Operational Amplifier:
Introduction to integrated circuits, operational amplified and its terminal properties, specification of M741

2L

Application of operational amplified: concept of virtual earth, inverting and non-inverting mode of operation, voltage summing, difference, constant gain multiplier, voltage follower, comparator, integrator, differentiator.

3L

Special Semiconductor devices:
Silicon Controlled Rectifier (SCR): constructional features, physical operation, characteristics, simple application (Saw tooth generator); concept of TRIAC, DIAC and UJT; insulated gate bipolar transistor (IGBT)

4L

Cathode Ray Oscilloscope:
Construction features of cathode ray tube, concept of dual beam CRO; application of CRO for different electrical measurements: amplitude frequency and phase of sine wave, Lissajous figure.

3L

Recommended reference Books:

Malvino	Electronic Principle
Millman & Halkias	Integrated Electronics
Mottershed	Electronics Devices & Circuits
Millman & Grabal	Microelectronics
Schilling & Belove	Electronics Circuits
Salivahanan	Electronics Devices & Circuits
Manish Mukherjee	Foundation Of Electronics Devices &Circuits.
Bhargava	Basic Electronics and Linear Circuits
Rakshit & Chattopadhyay	Foundation of Electronics
Storey	Electronics
S.C.Sarkar	Electronics Devices And Circuits. Vol. I&II.EPH
Basavrag	Basic Electronics,Vikas
Mann, K.	Introductory A.C. Circuits Theory, Universities Press
Ray Dilip Kumar	Physics of Semiconductor Devices, Universities Press
Chattopadhyay & Rakshit	Electronics :Fundamentals & Application, New Age
Paul P. John	Electronics Devices & Circuits,New Age
Poornachandra	Electronics Devices & Circuits

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Syllabus of First Year

(Common to All Branches of B.Tech Programme)

upto 2006

ENGINEERING CHEMISTRY

Code : Ch 201(Second Semester)
Contacts : 3L = 3
Credits : 3

Chemical Thermodynamics:

Concept of Thermodynamic System: diathermal wall, adiabatic wall, isolated system, closed system, open system, extensive property, intensive property

Introduction to first law of thermodynamics: different statements, mathematical form; internal energy: physical significance, mathematical expression (ideal and real gas), Enthalpy: physical significance, mathematical expression

3L

C_p and C_v: definition and relation; adiabatic changes; reversible and irreversible processes; application of first law of thermodynamics to chemical processes: exothermic, endothermic processes, law of Lovoisier and Laplace, Hess's law of constant heat summation, Kirchoff's law

3L

Second law thermodynamics; Joule Thomson and throttling processes; inversion temperature; evaluation of entropy: characteristics and expression, entropy change in irreversible process, entropy change for irreversible isothermal expression of an ideal gas, entropy change of a mixture of gases

2L

Work function and free energy: physical significance, mathematical expression for ideal and real gases obeying Vander Waals' equation, Gibbs Helmholtz equation 2L

Condition of spontaneity and equilibrium; non ideal systems, activity and activity coefficient, partial molar properties, chemical potential to multicomponent systems, Gibbs Duhem relation; application of thermodynamics to phase transition

4L

Atoms and Molecules:

Homonuclear and heteronuclear diatomics, covalent bonds, ionic bonds and electronegativity concepts, hybridzation and shapes of molecules, non-covalent interaction (Vander Waals and hydrogen bonding).

3L

Solid State Chemistry:

Introduction to stoichiometric defects (Schottky & Frenkel) and non-stoichiometric defects (Metal excess and metal deficiency); role of silicon and germanium in the field of semiconductor, transistors, rectifier and photovoltaic cells; the process for preparing microminiaturized semiconductor devices: integrated circuits

5L

Instrumental Methods of Analysis:

Introduction to instrumental metals such as IR, UV,-Vis, NMR and Mass spectrometry.

1L

Reaction Dynamics:

Reaction laws: rate and order; molecularity; first and second order kinetics; mechanism and theories of reaction rates (Transition state theory, Arrhenius equation)

2L

Transition and Metal Chemistry:

Structures of coordination compounds corresponding to coordination number 6; types of ligands; isomerism (geometrical, optical, ionization, linkage and coordination). 2L

Structure and Reactivity of Organic Molecule:

Inductive effect; resonance; hyperconjugatin; electromeric effect; carbanion and free radicals; brief study of some addition, elimination and substitution reactions 4L

Polymerization:

Concepts, classifications and industrial applications; polymerization processes, degree of polymerization (addition and condensation polymerization); preparation, structure and use of some common polymers: plastic (PE, PP, PVC bakelite), rubber (natural rubber, SBR, NBR), fibre (nylon 6,6, polyester);
conducting and semiconducting polymers 6L

Industrial Chemistry:

Solid, liquid and gaseous fuels; constituents of coal, carbonization of coal, coal analysis, proximate and ultimate analysis; classification of coal

Petroleum, gasoline, octane number, aviation fuel, diesel, cetane number; natural gas, water gas.

5L

Electrochemistry:
Conductance of electrolytic solutions, specific conductance, equivalent conductance, molar conductance and ion conductance; effect of temperature and concentration; basic ideas and inter ionic attractions; transport numbers and hydration ions, electrochemicals cells; cell emf and its thermodynamic significance; single electrode potentials and its applications; hydrogen half cell and calomel half cell; conductometric titrations: SA vs SB & SA vs WB; precipitation titration KCL vs $AgNO_3$

5L

Recommended reference Books:

Rakshit P. C.	Physical Chemistry
Dutta R. L.	Inorganic Chemistry
Levine	Physical Chemistry
Finar I. L.	Organic Chemistry
Sarkar Samir	Fuels and Combustion
Carey	Organic Chemistry
Glasston Samuel	Text Book of Physical Chemistry
Lee J. D.	Concise Inorganic Chemistry
Ghosh P.	Polymer Science and Technology of Plastics & Rubbers
Gopalan-	Applied Chemistry for Engineers,Vikas
Gopalan-	Concise coordination Chemistry,Vikas
Sharma	Physical Chemistry,Vikas
Raman	Physical Chemistry,Vikas
Rao Y.V.C.	Chemical Engineering Thermodynamics, Univs Press
Moore W.J.	Physical Chemistry, Orient Longman
Satyanarayan Rao V.	Polarography & Allied Techniques, Universities Press
Mann F.G.	Practical Organic Chemistry, Orient Longman
Sykes,P.	Guidebook to Mechanism in Org.Chems. Orient Longman
Sathyaranarana , D.N.	Electronic Absorptions Spectrocopy & Related Techniques, Univs Press
Negi A.S.	A Textbook of Physical Chemistry, New Age International
Chakraborty D.K.	**Solid State Chemistry, New Age International**
Singh S.K	Fundamentals of Engg Chemistry, New Age Inter.
Gupta M.C.	Atomic & Molecular Spectroscopy, New Age
Gowarikar V.R.	Polymer Science, New Age
Mishra G.S.	Introductory Polymer Chemistry, New Age
Mukherji S.M.	Organic Chemistry Vol.1,2,3, New Age
Nasipuri D.	Stereochemistry of Organic Compounds, New Age
Kalsi P.S	**Spectroscopy of Organic Compounds, New Age**
Kalsi P.S.	Organic Reactions & their Mechanism, New Age
Bansal R.K.	A Textbook of Organic Chemistry, New Age
Chakraborty D.K.	Absorption & Catalysis by Solids, New Age
Kalidas C.	Chemical Kinetic Methods, New Age
Reddy K.H.	Bioinorganic Chemistry

ENGINEERING CHEMISTRY LABORATORY

Code : Ch 291(Second Semester)
Contacts : 3/2 P
Credits: 1
Suggested List of Experiments

1. Acid –base titration (estimation of commercial caustic soda)
2. Redox titration (estimation of iron using permanganometry)
3. Complexometric titration (estimation of hardness of water using EDTA titration)

4. Preparation and analysis of a metal complex (for example thiourea / copper sulfate or nickel chloride / ammonia complexes)
5. Chemical Kinetics (determination of relative rates of reaction of iodide with H_2O_2 at room temperature (clock reaction)
6. Heterogeneous equilibrium (determination of partition coefficient of acetic acid between n-butanol and water)
7. Photochemical oxidation-reduction (study of photochemical reduction of ferric salt)
8. Viscosity of solutions (determination of percentage composition of sugar solution from viscosity)
9. Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution
10. pH- metric titration for determination of strength of a given HCl solution against a standard NaOH solution.

COMPUTING LAB

Code: CS 291(Second Semester)
Contacts: 3 P
Credits: 2
Exercises should include but not limited to:

1. DOS System commands and Editors (Preliminaries)
2. UNIX system commands and vi (Preliminaries)
3. Simple Programs: simple and compound interest. To check whether a given number is a palindrome or not, evaluate summation series, factorial of a number , generate Pascal's triangle, find roots of a quadratic equation
4. Programs to demonstrate control structure : text processing, use of break and continue, etc.
5. Programs involving functions and recursion
6. Programs involving the use of arrays with subscripts and pointers
7. Programs using structures and files.

BASIC ELECTRONICS ENGINEERING LAB

Code: EC 291(Second Semester)
Contacts: 3P
Credits: **2**

1. Familiarization with Electronic components such as Resistors, Capacitors, Diodes, Transistors etc.
2. Familiarization with electrical devices and measuring equipment like DC power supply, Multimeter, Trainer kit etc.
3. Familiarization with measuring and testing equipment like CRO, Signal generator.
4. Study on V-I characteristics of Junction Diode.
5. Study on V-I characteristics of Zener Diode.
6. Study on Half Wave and Full Wave rectifiers.
7. Study on characteristics of Field Effect Transistors.
8. Determination of Input offset voltage, Input Bias current, Slew rate of Op-Amp.
9. Determination of Common Mode Rejection Ratio, Bandwidth, Offset null of Op-Amp.
10. Characteristics Curve for common base emmitor & common collector transducers
11. Study of working of data acquisition system.

MATHEMATICS

Code: M 101(First Semester)
Contacts: 3L + 1 T = 4
Credits: 4
Infinite Series:

Sequence, Convergence and Divergence of Infinite series – and typical examples of convergent and divergent series. *1L*

Comparison test (statement only) and related problems *1L*

Ratio test (statement only) and related problems *1L*

Cauchy's root test (statement only) and related problems *1L*

Alternating series, Leibnitz's theorem (without proof), absolute convergence and related problems. *2L*

Calculus of Functions of One Variable:

Review of limit and continuity and differentiability. *1L*

Successive differentiation, Leibnitz's theorem (without proof but with problems of the type of recurrence relations in derivatives of different orders and also to find $(y_n)_0$): *3L*

Rolle's theorem (statement only); Mean Value Theorems—Lagrange & Cauchy (statement only), Taylor's theorem (without *6L*

proof and problems in respect of direct use and applications of the theorem only), Expansions of functions by Taylor and Maclaurin series. Maclaurin's expansion in infinite series of the functions: log (1+x), e^x , sinx, cosx, $(a+x)^n$, n being a negative integer or a fraction L'Hospital's Rule (statement only) and related problems.

Integration of *2L*

$\int_0^{\pi/2} \cos^n x\,dx,\ \int_0^{\pi/2} \sin^n x\,dx,\ \int_0^{\pi/2} \cos^n x \sin^m x\,dx,\ \int_0^{\pi/2} \cos\ mx \sin\ nx\,dx,$ m, n are positive integers.

Application:
Rectification *1L*

Three Dimensional Geometry (Cartesian):
Direction Cosine, Direction Ratio; Equation of a Plane (general form, normal form and intercept form); Equation of a Straight Line passing through one point and two points; Pair of intersecting planes representing a straight line. *4L*

Elementary ideas of surfaces like sphere, Right Circular Cone and Right Circular Cylinder (through Geometrical configuration) and equations in standard forms.

Calculus of Functions of Several Variables:
Introduction of Function of several variables and examples. *2L*
Knowledge of limit and continuity.

Partial derivative & related problems. Homogeneous Functions and Euler's Theorem (statement only) & Problems upto 3 variables. *3L*

Chain rules and related problems. *4L*
Differentiation of implicit functions & related problems.
Total differentials and related problems.

Maxima, minima and saddle points – definition, condition of extrema & problems for two variables. Lagrange's multiplier method – problems related to two variables only. *2L*

Line Integral, Double Integrals, Triple Integral – Discussion w.r.t. different types of limits and problems; Moment of Inertia, Centre of Gravity. *3L*

Jacobian – Definition and related problems for two variables. *2L*
Applications to areas and volumes, surface area of revolution.

Vector Calculus:
Scalar and Vector fields – Definition and Terminologies; Products: dot, cross, box, vector triple product. *2L*

Gradient, directional derivative, divergence, curl. (with problems). *2L*

Tangent planes and normals and related problems. *1L*

Statements of *4L*
Green's theorem, Divergence theorem, Stokes' theorem with applications.

Total 48L

References / Books:

1. G.B.Thomas and R.L. Finney, "Calculus and Analytic Geometry", 6th edition, Addison Wesley / Narosa, 1985.
2. Piskunov, "Differential and Integral Calculus", Vol-I & II, Mir Publishers, Moscow, 1979.
3. B.S. Grewal "Engineering Mathematics", S. Chand & Co., New Delhi.
4. Integral Calculus, Das & Mukherjee
5. An Introduction to Real Analysis- S.K.Mapa
6. Higher Algebra – Lahiri & Roy
7. Higher Algebra, Ghosh & Chakraborty
8. Higher Algebra, Bernard & Child

9. Differential Calculus, Maity & Ghosh
10. Integral Calculus, Maity & Ghosh
11. Engineering Mathematics, Prof.T.Majumdar
12. An Introduction to Analysis, Mallick & Arora
13. Undergraduate Engg Math- Jana, Vikas
14. Engineering Math Vol 1,2,3- Lakshami, Vikas
15. Calculus of One Vairable – Pandey G.S. (New Age International)
16. Differential Calculus – Dhami H.S. (New Age International)
17. Integral Calculus – Dhami H.S. (New Age International)
18. Numerical Methods for Engineers – Gupta S.K. (New Age International)
19. A Textbook of Engg Maths Vol.1 & Vol.2 – Dutta D. (New Age Inter.)
20. Advanced Engg. Mathematics By D.P. Das, Cyber Tech

MATHEMATICS
Code: M 201(Second Semester)
Contacts: 3L + 1T = 4
Credits: 4

Linear Algebra:

Introduction to the idea of a matrix; equality of matrices; special matrices. Algebraic operations of matrices: commutative property, associative property and distributive property. Transpose of a matrix (properties $(A^t)^t = A$, $(A+B)^t = A^t + B^t$, $(cA)^t = cA^t$, $(AB)^t = B^tA^t$ to be stated (without proof) and verified by simple examples). Symmetric and Skew symmetric matrices. *2L*

Properties of determinant (statement only); minor, co-factors and Laplace expansion of determinant; Cramer's rule and its application in solving system of linear equations of three variables. *2L*

Singular and non-singular matrices; adjoint matrix; inverse of a matrix $[(AB)^{-1} = B^{-1}A^{-1}$ to be stated and verified by example. Elementary row and column operations on matrices; definition of rank of a matrix; determination of rank of a matrix using definition. *2L*

System of Linear Equations:

Consistency and Inconsistency. Gauss elimination process for solving a system of linear equations in three unknowns. *2L*

Vector Space:

Basic idea of set, mapping, Binary Composition and Scalar field. Definition of vector space over the field of real numbers; Examples of vector space; Definition of sub-space of a vector space and a criterion for a sub-space; Definition of Linear combination, Linear independence and linear dependence of vectors with examples. Definition of basis and dimension of vector space; Definition of Linear transformation: Definition of kernel and images of a Linear transformation; Kernel and Images of a Linear Transformation forming sub-spaces; Nullity and Rank of a Linear Transformation; Dim Ker T + Dim Im T = Dim V; Definition of Inner product space; Norm of a vector; Orthogonal and Ortho-normal set of vectors. *7L*

Eigenvalues and Eigenvectors of a matrix; Eigenvalues of a Real Symmetric Matrix; Necessary and Sufficient Condition of diagonalization of matrices (statement only); Diagonalization of a matrix (problems restricted to 2 x 2 matrix). *2L*

Ordinary Differential Equations (ODE):

Definition of order and degree of ODE; *4L*
ODE of the first order: Exact equations; Definition and use of integrating factor; Linear equation and Bernoulli's equation. ODE of first order and higher degree, simple problems.

General ODE of 2nd order: D-operator method for finding particular integrals. Method of variation of parameters. Solution of Cauchy-Euler homogeneous linear equations. Solution of simple simultaneous linear differential equations. *6L*

Verification of Legendre function (P_n (x)) and Bessel function (J_n (x)) as the solutions of Legendre and Bessel equations respectively. Graphical representations of these solutions. *2L*

Laplace Transform (LT):

Definition; Existence of LT; LT of elementary functions; First and second shifting properties; Change of scale property; LT of derivative of functions. LT of (t^n f (t)), LT of f (t) / t^n; LT of periodic function and unit step function. Convolution theorem (statement only). *6L*

Inverse LT; Solution of ODE's (with constant coefficients) using LT. *4L*

Numerical Methods:

Error: Absolute, Percentage, Relative errors. Truncation error, Round off error. *5L*

Difference operator (forward, backward, central, shift and average operators); Different table, Propagation of Error. Definition of Interpolation and Extra-polation. Newton's forward and backward interpolation formula; Lagrange interpolation formula and corresponding error formulae (statement only).

Numerical Differentiation: Using Newton's forward and backward interpolation formula. *4L*

Numerical Integration: Trapezoidal rule and Simpson's 1/3rd rule and corresponding error terms (statement only).

Total 48L

Recommended Reference Books:

Kreyszig E.	Advance Engineering Mathematics
Krishnamurthy V., Mainra V.P. and Arora J.L.	An Introduction to Linear Algebra
Boyce and Diprima	Elementary Differential Equations and Boundary Value Problems
Grewal B.S.	Engineering Mathematics
S.K.Rathor	Higher Engineering Mathematics II.EPH
Lakshmninarayn	Engg Math,Vikas
Jana	UG Engg. Mathematics,Vikas
Chakraborty A.	Elements of Ord.Diff. Equations,New Age
Bhattacharya P.B.	First Course in Linear Algebra,New Age
Rao Sarveswar A.	Engineering Mathematics, Universities Press
Gupta S.K.	Numerical Methods for Engineers, New Age
Jain M.K.	Numerical Methods for Sc. & Engg Computation, New Age International

Jain M.K.	Numerical Solutions of Differential Equations
Balachandra Rao	Numerical Methods with Programs in Basic, Fortran Pascal and C++
Dutta N.	Computer Programming & Numerical Analysis: An Integral Approach,Universities Press
Rao S.B.	Differential Equations with Applications & Programs, Universities Press
Murray D.A.	Introductory Course in Differential Equations
Bagchi S.C.	First Course on Representation Theory & Linear Lie Groups, Universities Press
Arumugam	Engineering mathematics,I,II & III, Scitech

ME 101 : Mechanical Sciences(First Semester)
Contact : 3L + 1T = 4
Credit : 4
Assuming 12 weeks available,
No. of periods : 12 x 4 = 48

Sl. No.	Topics to be covered	Assigned Lectures & Tutorials	Recommended Text Books

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Syllabus of First Year

(Common to All Branches of B.Tech Programme)

upto 2006

1.	Introduction to Statics: Fundamental idealization : Particle and Rigid body concept; Types of forces (collinear, concurrent, parallel, concentrated, distributed), Vector and scalar quantities, Transmissibility of a force (sliding vector); Lame's Theorem	2L	Engineering Mechanics, Vol-I (Statics) by Meriam & Kraige Chap. – 1 & 2
2.	Introduction to Vector Algebra, Vector Operations, Parallelogram law, Free vector, Bound Vector; representation of Forces and Moments in terms of i,j,k; Cross product and Dot product and their applications.	3L + 1T	Engineering Mechanics Statics & Dynamics by I.H. Shames. Chap – 2 Prob. 22,23,26,31,35,43,45
3.	Two and three dimensional force systems; Moment and Couple, Varignon's theorem, Resultants, Free body concept. Resolution of a coplanar force by its equivalent Force-couple system.	**3L**	Engineering Mechanics, Vol-I (Statics) by Meriam & Kraige Chap – 2, **Prob. 2,7,13,17,20,32,37,45, 51,58,60,63,66,68,83,91,92, 94, 97, 102** - DO – [Chap – 3] Prob. 4,8,10,21,26,28,63,65,71,80
4.	Concept of Equilibrium in Two and Three dimensions. Equations of Equilibrium	**2L + 1T**	- DO – [Chap – 6] Prob. 3,5,9,15
5.	Concept of Friction; Laws of Coulomb friction, Angle of Repose Distributed Force : Centroid and Centre of Gravity	**2L + 1T**	- DO – [Chap – 5] Prob. 6,15,18,39,41,42,51, 53,72
6.	Moments of inertia of plane figures : M.I. of plane figures : MI of plane figure with respect to an axis in its	2L	- DO – [Chap Appendix A & B] Prob. A/1, A/12, A/21, A/29, A/33
7.	plane; MI of plane figure with respect to an axis perpendicular to the plane of the figure, Parallel axis theorem; Mass moment of inertia of symmetrical bodies, e.g. cylinder, sphere, rod. Principle of virtual work with simple application	3L + 1T	- DO – [Chap – 7] Prob. 1, 2, 3
8.		**2L + 1T**	

9.	Concept of simple stresses and strains: Normal stress, Shear stress, Bearing stress, Normal strain, Shearing strain, Hooke's law, poisson's ratio, Examples	**2L + 1T**	Elements of Strength of Materials by Timo & Young, ** [Chap – 1] Prob. Art 1.2, 3,4,5,8,9,10 and problem sheet. Art 1.3, Prob. 3,5,7
10.	Stress and strains under axial loading stress-strain diagram of ductile materials, Working stress, Factor of safety, Proportional limit, Elastic Limit, Ultimate stress, Yielding, Modulus of elasticity, Definitions of malleability, ductility, toughness and resilience.	**2L**	- DO – [Chap – 1.1]
11.	Concept of thermal stress	**1L**	- DO – [Chap – 1] **Problem Sheet**
12.	Introduction to Dynamics : Kinematics and Kinetics; Rectilinear motion of particles; determination of position velocity and acceleration – under uniform rectilinear motion (uniform and nonuniform accelerated rectilinear motion), Relative motion, construction of x-t, v-t and a-t graphs (simple problems)	2L + 1T	Engineering Mechanics (Vol-II) Dynamics by Mariam & Kraige [Chap – 2] Prob. 2,4,8,12,23,24,174,194 and Problem sheet
13.	Plane curvilinear motion of particles : Rectangular components (Projectile motion), Normal and Tangential components, Radial and Transverse components, simple problems	2L + 1T	- DO – [Chap – 2] Prob. 57,72,83,98,123,126 and Problem sheet
14.	Plane kinematics of Rigid bodies : Translation and Rotation Kinetics of particles : Rectilinear motion of particles; Plane kinetics of Rigid bodies : Rectilinear motion	2L + 1T	- DO – [Chap – 5] Prob. 1,3,6,18 and Problem sheet
15.	Equation of motion, D.Alembert's principle Principle of work and energy applied to particle and rigid bodies, Principle of conservation of energy, Power and efficiency, simple examples	2L + 1T	- DO – [Chap – 3 & 6] Chap 3. Prob. 2,13,18,23 Chap 6. Prob. 3,9,25,37,41
16.	Principle of Linear Impulse and Momentum	2L + 1T	- DO – [Chap – 3 & 6] Chap 3. Prob. 91,94,100 Chap 6. Prob. 112, 115, 116 and Problem Sheet
17.		2L + 1T	- DO – [Chap – 3 & 6] Chap 3. Prob. 159,162, 189,191,197 and Problem sheet

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Syllabus of First Year

(Common to All Branches of B.Tech Programme)

upto 2006

36L + 12T = 48 Periods

**** Strength of Materials by S. Ramamruthan may be consulted for problems.**

The students should attempt solving problems given in the Question Bank (Problem Sheet) besides the problems as indicated against each topic of the Recommended Books.
Book: Fundamentals of Mechanical Sciences, Bhattacharya & Mukhopadhyay,Pearson Education

MECHANICAL SCIENCES (ME 101)
B Tech 1st Year, 1st Semester

Question Bank

Problems on Equilibrium Systems

1. Two smooth spheres, each of radii r =25 cm and weight Q = 40 kgf rest in a horizontal channel having a vertical wall of distance b = 90 cm. Find the forces exerted on the walls and the floor at the points of contact.

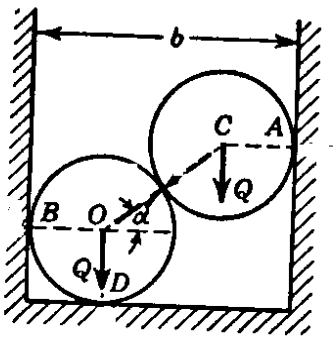


Fig 1

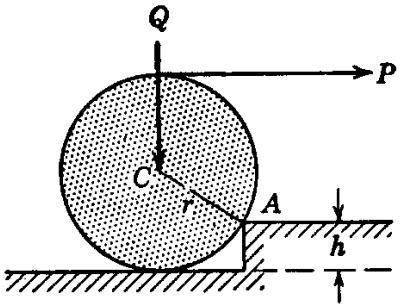
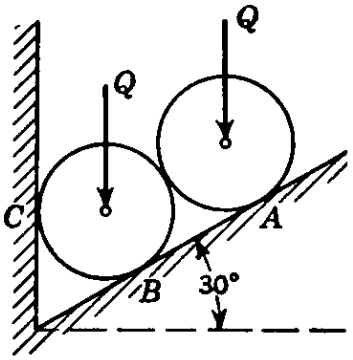


Fig 2

2. A roller of radius r=12 cm and Q=500 Kgf is to be rolled over a curb of height h=6 cm by a horizontal force P applied to the end of a string wound around the circumference of the roller. Find the magnitude of P required to start the roller over the curb. There is sufficient friction between the roller surface and the edge of the curb to prevent slip at A.

3. Two inclined rollers, each of weight Q=100 Kgf are supported by an inclined plane and a vertical wall as shown below. Assuming smooth surfaces, find the reactions induced at the points A, B and C.



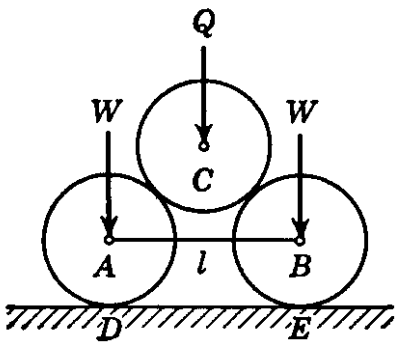


Fig 3 Fig 4

4. Two smooth circular cylinders, each of weight W=100 Kgf and radius r=6 cm are connected at the centres by a string AB of length l=16 cm and rest upon a horizontal plane, supporting above them a third cylinder of weight Q=200 Kgf and radius r=6 cm. Find the force S in the string AB and pressure produced on the floor at D and E.

5. If the string AB is horizontal, find the angle that the string AC makes with the horizontal when the ball is in a position of equilibrium. Also find the pressure R between the ball and the plane.

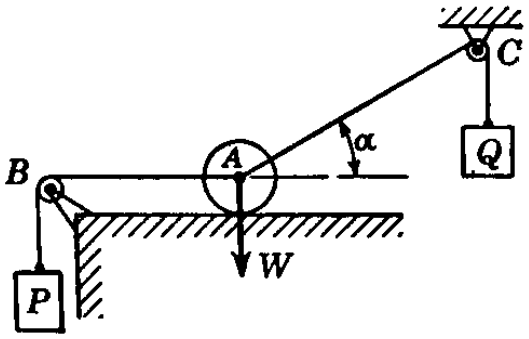
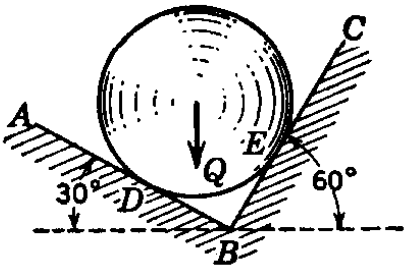


Fig. 5

6. A ball of weight Q=12 Kgf rests in a right angled trough as shown. Determine the forces exerted on the sides of the trough at D and E if all surfaces are perfectly smooth.



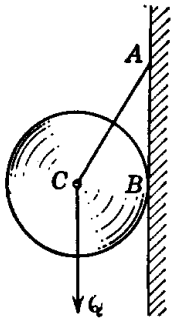


Fig 6 Fig 7

7. A circular roller of weight Q=100 Kgf and radius r=6 cm hangs by a tie rod AC=12 cm and rests on a smooth vertical wall at B. Determine the tension s in the tie rod and force R_B exerted against the roller.

8. A right circular roller of weight W rests on a smooth horizontal plane and is held in position by an inclined bar AC find the tension S in the bar AC and vertical reaction R_B at B, if there is a horizontal force P acting at C.

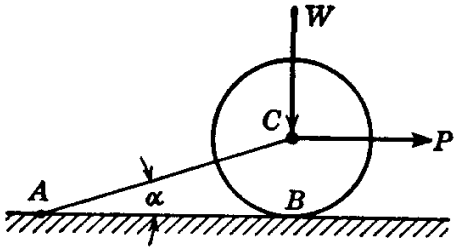


Fig 8

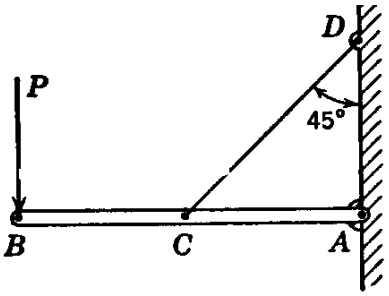


Fig 9

9. A horizontal beam AB is hinged to a vertical wall at A and supported by a tie rod CD. Find the tension s in the tie rod and reaction at A.

10. A 150 Kg mass stands on the middle point of a 50 Kg ladder. Assuming that floor and wall are perfectly smooth find the reactions, R_A and R_B at A and B.

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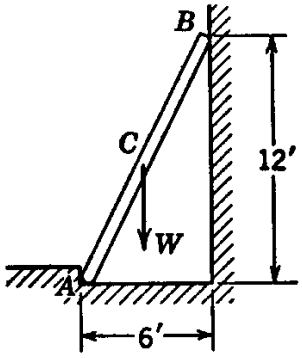


cm

Fig. 10

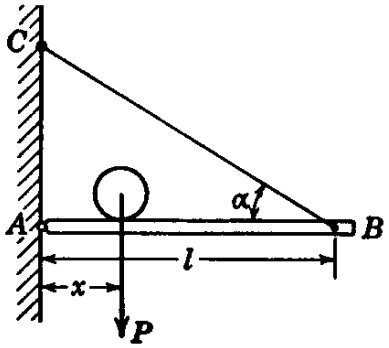
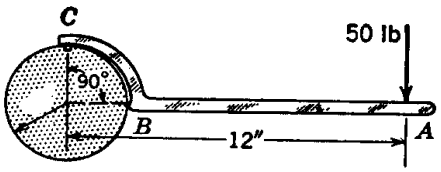


Fig 11

11. A horizontal prismatic bar AB of negligible weight and length l is hinged to a vertical wall at A and supported at B by a tie-rod BC that makes α with the horizontal. A weight P can have any position along the bar. Determine the tension S in the tie-bar.

12. Determine the forces exerted on the cylinder at B and C by the spanner wrench due to a vertical force of 50 kgf applied to the handle. Neglect friction at B.

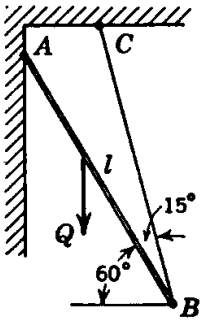
Fig 12



13. A bar AB of length l is hinged at A as shown. At any point along its length a vertical load Q can be applied. Determine the position of this load for which the tensile force S in the cable BC will be a maximum and evaluate the same if the various angles are as shown in the figure. In calculation neglect the weights of the bar and the cable.

Fig 13

14. A horizontal platform CD carries a truck of weight Q and is rigidly attached to the vertical bar AB, which is hinged at the



bottom to horizontal bar AE and at the top in the horizontal lever BFG. Determine the weight Q of the truck, if a known weight W hanging at G holds the platform and its load in equilibrium. The weight of the empty platform is just balanced by that of the lever.

15. A prismatic bar of weight Q and length l rests at A against a smooth horizontal floor, and under the action of its gravity force Q presses against supports at C and D. Neglecting friction, determine the reactions at A, D and C.

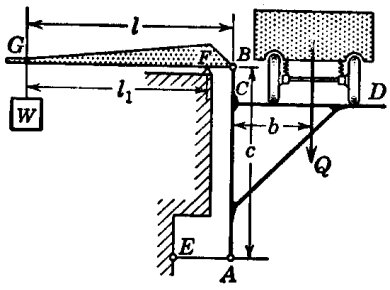


Fig 14

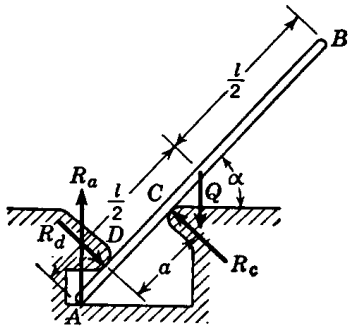


Fig 15

16. A heavy block of weight W rests on a rough horizontal plane as shown. Hinged to this block is a slender bar AB of length l which leans against a small frictionless roller at D and carries a vertical load P at its free end B. Find the magnitude of P for which the sliding of the block will impend if the coefficient of friction on the horizontal plane is μ. The following numerical data are given : θ = 30°, l = 30 cms, h = 10 cms, μ=1/3. Neglect the weight of the bar completely.

17. A smooth right circular cylinder of radius r rests on a horizontal plane and is kept from rolling by an inclined string of length 2r. A prismatic bar of length 3r and weight Q is hinged at point A and leans against the roller as shown. Find the tension S that will be induced in the string AC.

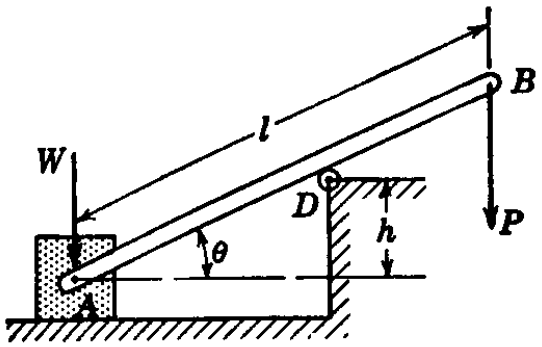


Fig 16

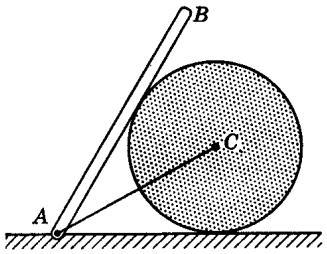


Fig 17

Problems on Friction

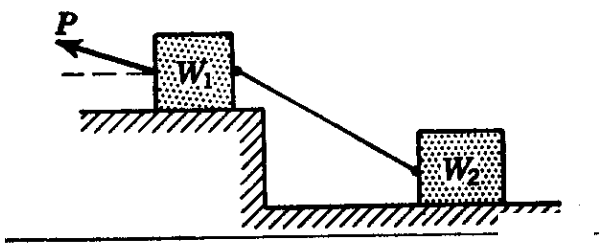
18. Two blocks of weight W_1 and W_2 rest as shown. If the angle of friction of each block is φ, find the magnitude and direction of the least force P applied to the upper block that will induce sliding.

19. Two blocks connected by a horizontal link AB are supported on two rough planes as shown. The coefficient of friction for block A on the horizontal plane is μ = 0.4. The angle of friction for block B on the inclined plane is 15°. What is the smallest weight of the block A for which equilibrium will exist?

Fig 18

Fig 19

400



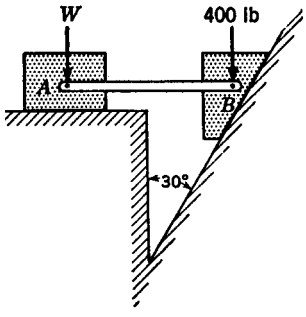


FIG. G

20. Two blocks of weights W_1= 200 kgf and W_2= 300 kgf are joined by a cord parallel to the plane inclined at an angle α with the horizontal. Find the angle α for which sliding will impend. What is the tension in the cord. Given, coefficient of friction for block 1 and 2 are 0.20 and 0.50 respectively. Investigate the case when μ_1=0.5 and μ_2=0.2.

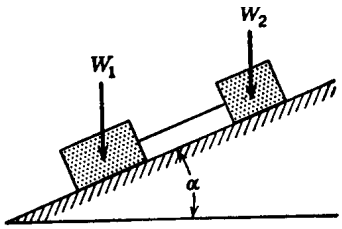


Fig 20

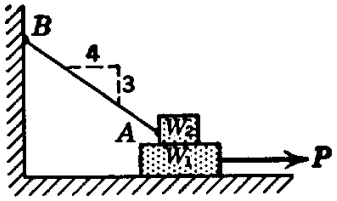


Fig 21

21. A block of weight W_1 = 200 kgf rests on a horizontal surface and supports on top of it another block of weight W_2=50 kgf. The block W_2 is attached to a vertical wall by the inclined string AB. Find the magnitude of the horizontal force P applied to the lower block as shown, that will be necessary to cause slipping to impend. The coefficient of static friction for all contiguous surfaces is μ = 0.3.

22. Two identical blocks A and B are connected by a rod and rest against vertical and horizontal planes respectively. If sliding impends when θ=45°, determine the coefficient of friction, μ, assuming it to be the same at both floor and wall.

Fig 22

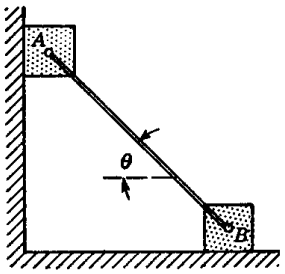
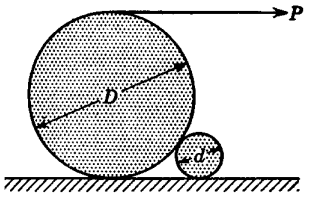


Fig 23



23. Two heavy right circular rollers of diameters D and d respectively rest on a rough horizontal plane. The larger roller has a string wound around it to which a horizontal force P can be applied. Assuming that coefficient of friction μ has the same value for all surfaces of contact, determine the necessary condition under which the larger roller can be pulled over the smaller one.

24. A solid right circular cone of altitude h = 12 cm and radius r = 3 cm has its cg C on its geometric axis at a distance h/4 above the base. This cone rests on the inclined plane AB which makes an angle of 30° with the horizontal and for which the angle of friction is 0.5. A horizontal force P is applied to the vertex O of the cone and acts in the vertical plane of the figure. Find the maximum and minimum values of P consistent with equilibrium of the cone of weight W = 10 kgf.

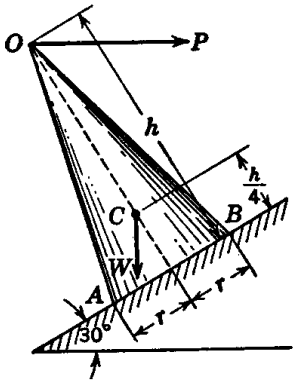


Fig 24

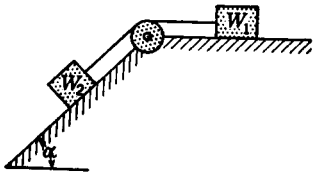


Fig 25

25. Two rectangular blocks of weights W_1 and W_2 are connected by a flexible cord and rest upon a horizontal and an inclined plane respectively, with the cord passing over a pulley as shown. In the particular case where $W_1=W_2$ and the coefficient of static friction μ is the same for all contiguous surfaces, find the angle α of inclination of the inclined plane at which motion of the system will impend. Neglect friction in the pulley.

26. A short right circular cylinder of weight W rests in a horizontal V notch having the angle 2α as shown. If the coefficient of friction is μ find the horizontal force P necessary to cause slipping to impend.

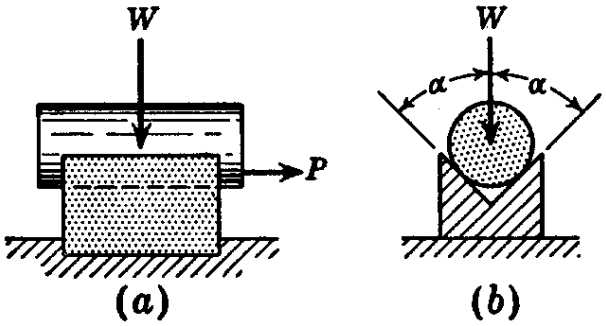
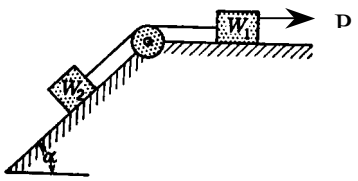


Fig 26

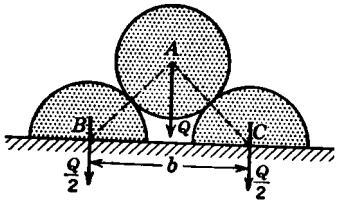
27. Two rectangular blocks e cord and rest upon a horizontal and an inclined plane respectively with the co
Find the least value of P that will start the system of blocks moving to the right. Coefficient of friction of each block is 0.30.

Fig 27



28. A smooth circular cylinder of weight Q and radius r is supported by two semi-circular cylinders each of the same radius r and weight Q/2 as shown. Find the maximum value of distance b for which motion will impend.

Fig 28



29. In the figure shown, find the minimum value of horizontal force P applied to the lower block that will keep the system in equilibrium?Given, coefficients of friction between lower block and floor = 0.25, between the upper block and the vertical wall = 0.30, between the two blocks = 0.20.

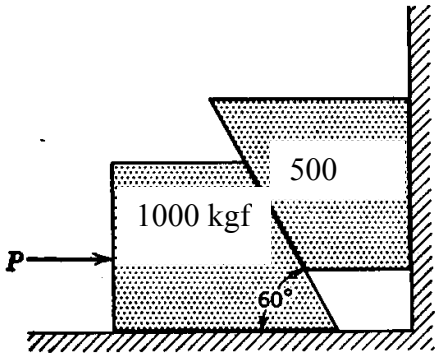


Fig 29

30. A screw jack has a square thread of 75 mm mean diameter and 15 mm pitch. The load on the jack revolves with the screws. The coefficient of friction at the screw thread is 0.05. (I) Find the tangential force to be applied to the jack at 360 mm radius, so as to lift a load of 6 kN weight. (ii) State whether the jack is self locking. If yes, find the torque to lower the load. If not, find the torque which must be applied to keep the load from descending.

31. A short semi-circular right cylinder of radius r and weight W rests on a horizontal surface and is pulled at right angles to its geometric axis by a horizontal force P applied at the middle B of the front edge as shown. Find the angle α that the flat face will make with the horizontal plane just before sliding begins if the coefficient of friction at the line of contact A is μ. The gravity force W must be considered as acting at the centre of gravity C as shown in the figure.

32. The ends of a heavy prismatic bar AB are supported by a circular ring in a vertical plane as shown. If the length of the bar

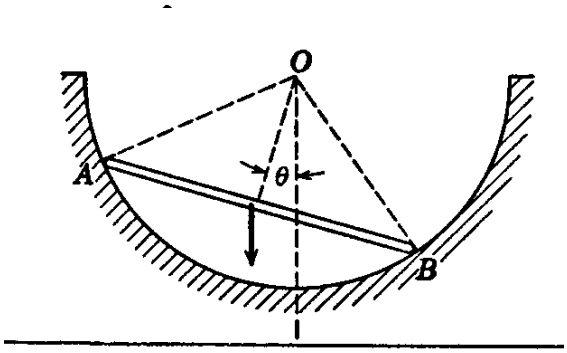


Fig 30

is such that it subtends an angle of 90°in the ring and the angles of friction at A and B are each ψ, what is the greatest angle of inclination θ that the bar can make with the horizontal in a condition of equilibrium?.

33. To raise a heavy stone block weighing two tonnes the arrangement shown in the figure is used. Wha will be necessary to apply to the wedge in order to raise the block if the coefficient of friction for all co μ=1/4? Neglect weight of the wedge.

Fig 31

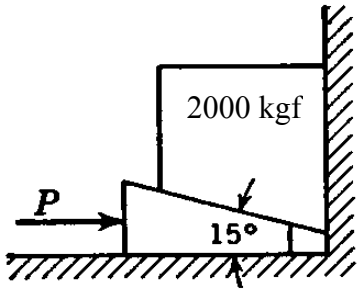


Fig 32

Problems on Moment of Inertia and Centre of Gravity

34. 16. Determine the axial moment of inertia of the T section shown in Fig 33 about the centroidal axis parallel to the base.

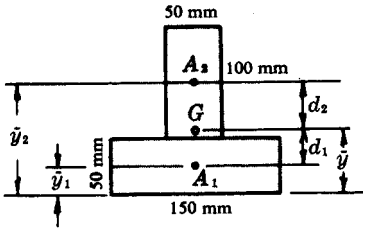


Fig 33

35. Determine the axial moment of inertia for the channel shown in Fig 34 about a centroidal axis parallel to the base 'b'.

Fig 34

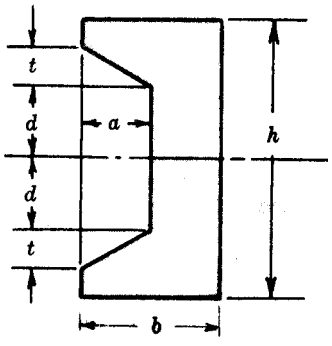
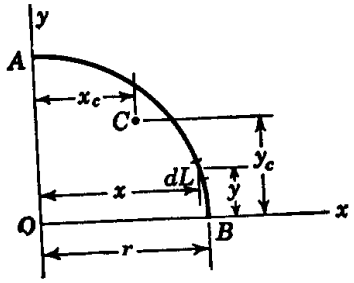


Fig 35



36. Determine by integration the coordinates of the centroid of the quadrant AB of the arc of a circle of radius r.

37. Determine the coordinates of the centroid C of the area of the circular sector OBD of radius r and central angle α.

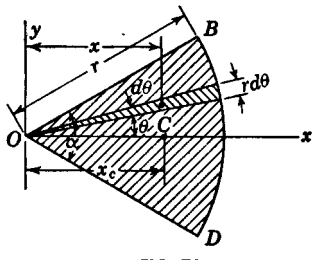


Fig 36

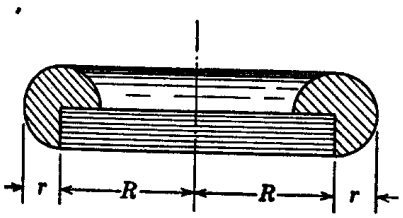
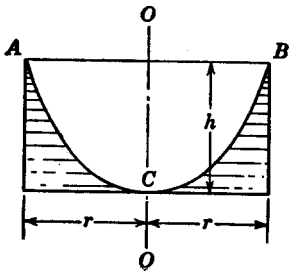


Fig 37

38. Using the second theorem of Pappus calculate the volume of the ring shown in Fig 37 if R = 10 cm and r = 4 cm

39. A right circular cylindrical tank containing water spins about its vertical geometric axis OO at such speed that the free water surface is a paraboloid ACB. What will be the depth of water in the tank when it comes to rest?

Fig 38



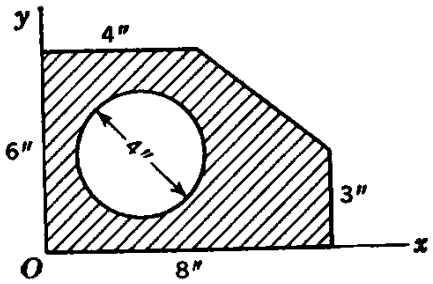


Fig 39

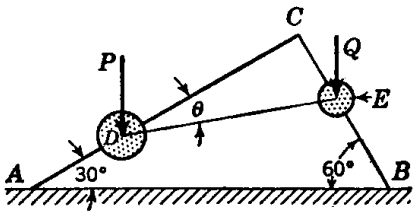


Fig 40

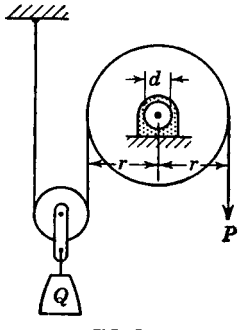
40. Referring to Figure 39 determine the coordinates of the centre of the circular hole cut in a thin plate so that this point will be the centroid of the remaining shaded area.

Problems on Virtual Work

41. Using the principle of virtual work find the value of the angle θ defining the configuration of equilibrium of the system shown in Fig 40. The balls D and E can slide freely along the bars AC and BC but the string DE connecting them is inextensible.

42. A load Q is hoisted by the pulley arrangement shown in Fig 41. Determine the magnitude of the pull P required to raise the load Q if r = 14 cm, d= 4 cm and the coefficient of friction in the journals supporting the pulleys is μ = 0.25. Neglect friction in the movable pulley. What is the efficiency of this device?

Fig 41



West Bengal University of Technology

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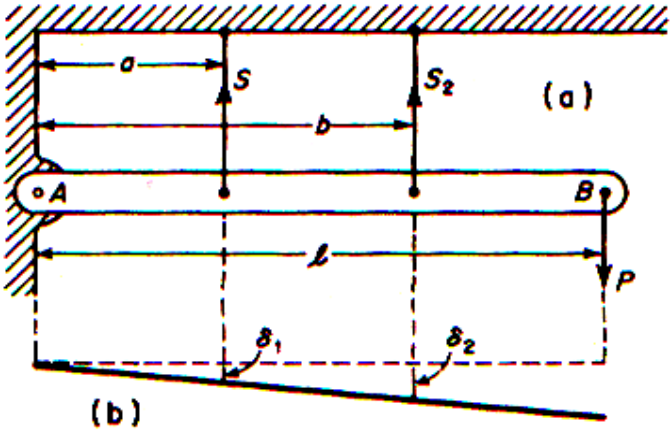
Syllabus of First Year

(Common to All Branches of B.Tech Programme)

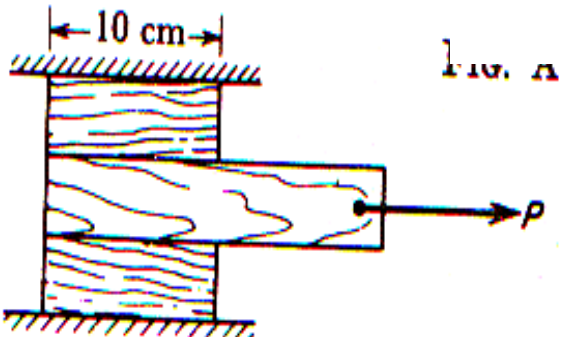
upto 2006

Problems on Stress and Strain

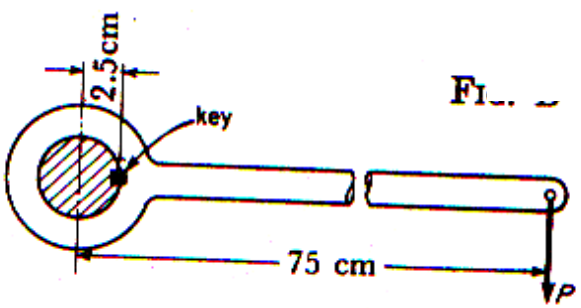
43. A rigid bar AB is hinged at A and supported in a horizontal position by two identical vertical steel wires as shown in Fig. 1. Find the tensile forces s_1 and s_2 induced in these wires by a vertical load P applied at B as shown.



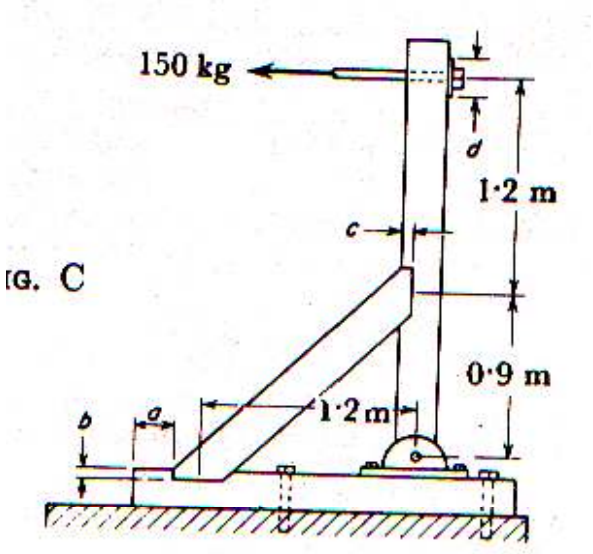
44. Three pieces of wood having 3.75 cm. × 3.75 cm square cross section s are glued together and to the foundation as shown in Fig.2. The horizontal force P=3000Kg. What is the average shear stress in each of the glued joints?



45. In fig.3 a lever is attached to a spindle 2.5 cm in diameter by means of a square key 6m.m. ×6m.m. if the average shear stress in the key not to exceed 700kg/cm^2 , what is the safe value of the load P applied to the end of the lever.



46. The frame shown in Fig.4 is made up of 10cm×10cm square wood posts for which the allowable stress in shear parallel to grain is τ_w =7 Kg/cm^2, while that in compression perpendicular to the grain is σ_w=28 Kg/cm^2 , while that in safe values of the dimensions a , b and c .The vertical post is pinned to the sill at its lower end .

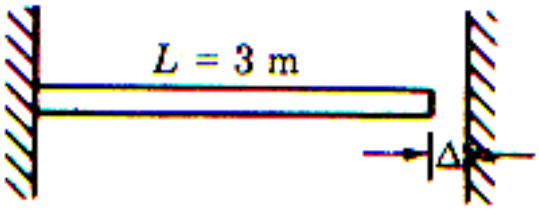


Problems on Thermal Stresses

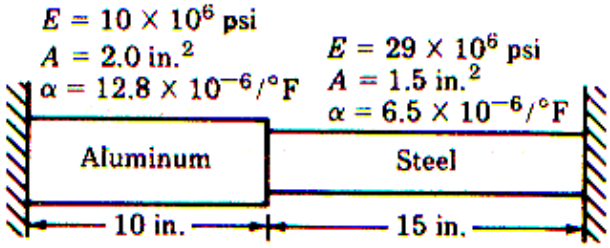
47. Steel railroad 10 m long are laid with a clearance of 3 mm at a temperature of 15degree centigrade. At what temperature will the rails just touch? What stress would be induced in the rails at that temperature if there were no initial clearance? Assume α = 11.7μm/(m.°C) and E=200Gpa.

48. A steel rod 3 ft long with a cross-sectional area of 0.25 sq. inch. is stretched between two fixed points. The tensile force is 1200 lb at 40°F. Using E=29×10 ^{6} psi and α = 6.5×10^{-6} in/in °F, Calculate (a). the temperature at which the stress in the bar will be 10 ksi; and (b). the temperature at which the stress will be zero.

49. A bronze bar 3 m long with a cross-sectional area of 320 mm^2 is placed between two rigid walls as shown in fig 1. At a temperature of –20 °C, the gap Δ = 2.5 mm. Find the temperature at which the compressive stress in the bar will be 35 Mpa. Use α = 18×10^{-6} m/m °C and E=80Gpa.



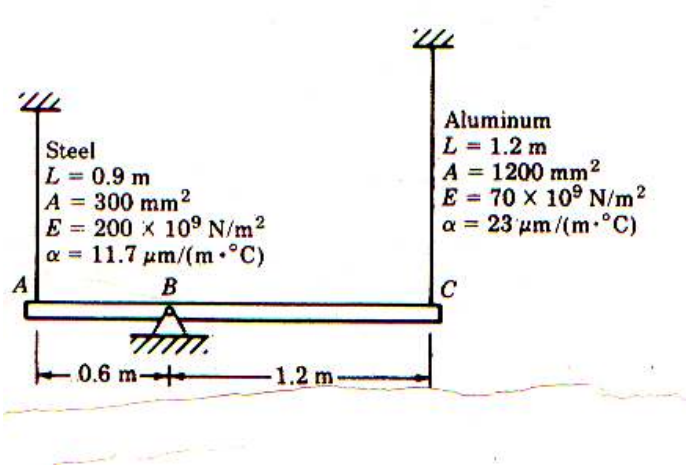
50. Calculate the increase in stress for each segment of the compound bar shown in fig 2. If the temperature increases by 100 °F. Assume that the supports are unyielding and that the bar is suitably braced against buckling,



51. At a temperature of 80 °C, a steel tire 12 mm thick and 90 mm wide that is to be shrunk onto a locomotive driving wheel 2m in diameter ,just fits over the wheel, which is at a temperature of 25°C.

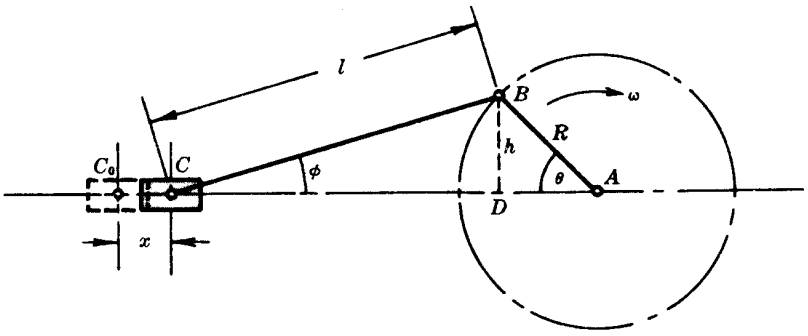
52. Determine the contact pressure between the tire and wheel after the assembly cools to 25°C. Neglect the deformation of wheel caused by the pressure of the tire. Assume Use $\alpha = 11.76\times10^{-6}$ m/m °C and E= 200Gpa.

53. The rigid bar ABC in fig. 3 is pinned at B and attached to the two vertical rods. Initially, the bar is horizontal and the vertical rods are stress-free. Determine the stress in the aluminum rod, if the temperature of steel rod is decreased by 40 °C. Neglect the weight of the bar ABC.



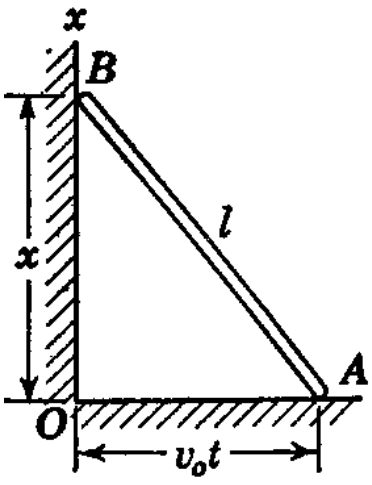
Problems on Rectilinear and Curvilinear Motion of Particles

54. Determine the linear displacement, velocity and acceleration of the crosshead C in the slider crank mechanism shown in Fig. 1 for any position of the crank R which is rotating at a constant angular velocity ω rad/s.



55. A slender bar AB of length, l which remains always in the same vertical plane has its ends A and B constrained to remain in contact with a horizontal floor and a vertical wall, respectively as shown in fig 2. The bar starts from avertical position, and the end A is moved along the floor with constant velocity v_o so that its displacement $OA=v_ot$. Find the displacement time, velocity time and acceleration time equations for the vertical motion of the end B of the bar.

56. A wheel of radius r rolls without slip along x axis with constant speed as shown in Fig 3. Investigate the motion of a point



A on the rim of the wheel which starts from the origin O.

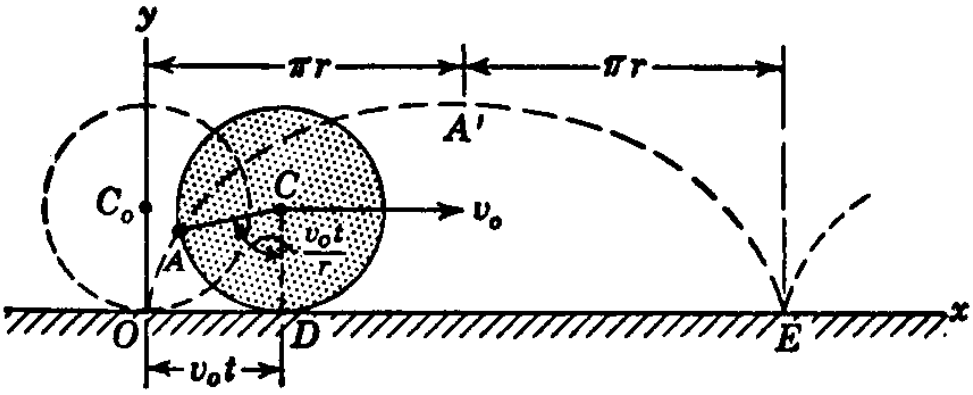


Fig. 3

57. A gun emplacement is shown on a cliff in fig. the muzzle velocity of the gun is 1,000 m/sec. At what angle α must the gun point in order to hit target A shown in the Fig. 4? Neglect friction.

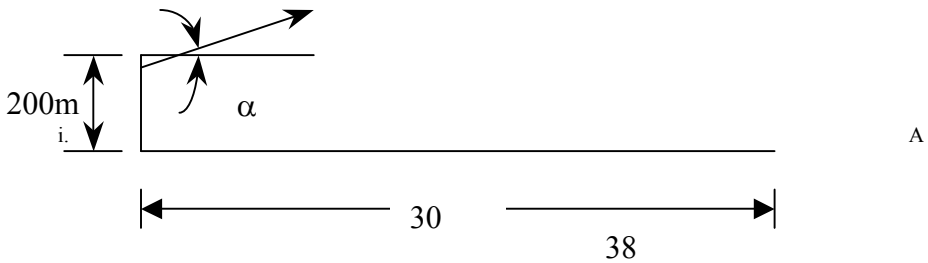


Fig. 4

58. A point P moves on a circular path in a counterclockwise direction so that the length of arc it sweeps out is $s=t^3+3$. The radius of the path is 4 m. The units of s and t are m and secs respectively. Determine the axial components of velocity (v_x, v_y) and the axial components of acceleration (a_x, a_y) when t=1s.

Problems on Translation & Rotation of rigid bodies

59. The pinion A of the hoist motor drives gear B which is attached to the hoisting drum. The load L is lifted from its rest position and acquires an upward velocity of 2 m/sec in a vertical rise of 0.8 m with constant acceleration. As the load passes this position compute (a) the acceleration of point C on the cable in contact with the drum and (b) the angular velocity and angular acceleration of the pinion A.

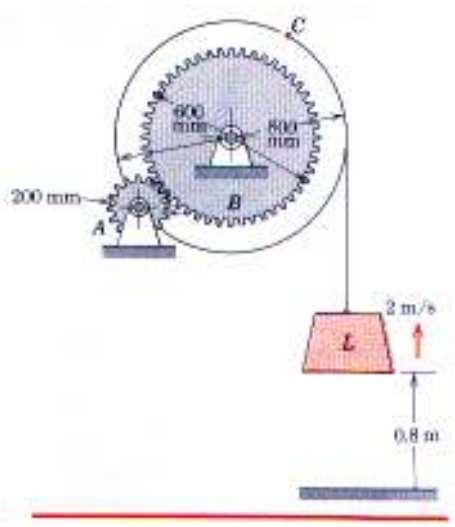
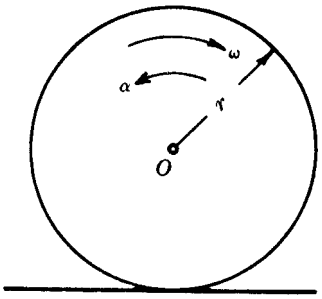


Fig. 5

60. A wheel 3 m in diameter rolls to the right on a horizontal plane with an angular velocity of 8 rad/s (clockwise) and an angular acceleration counterclockwise of 8 rad/s^2 as shown in fig 6. The latter merely indicates that the angular velocity of the wheel is decreasing. Determine the linear velocity and acceleration of the top point B on the wheel.

Fig. 6



61. In the fig. 7 the cylinder of radius r rolls on the surface of radius R. Formulate the equations for such type of motion.

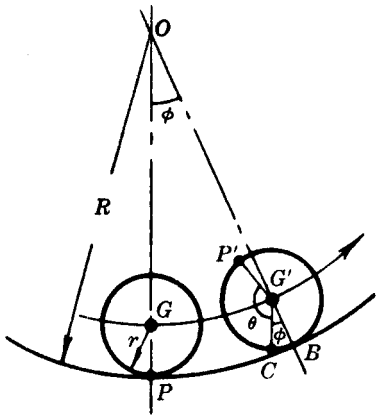


Fig. 7

62. A slender prismatic bar OA of weight W and length L can rotate freely about the fixed axis through O normal to the plane of the figure. By means of a horizontal bar AB and a crankshaft with crank radius r and crankpin D freely sliding in the slot DC, a simple harmonic motion is given to the end A of the bar OA. Determine the force S in the bar AB, assuming that its mass is negligible.

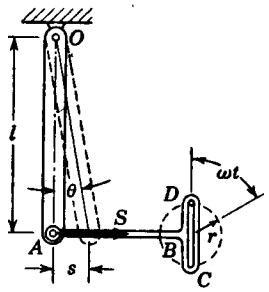
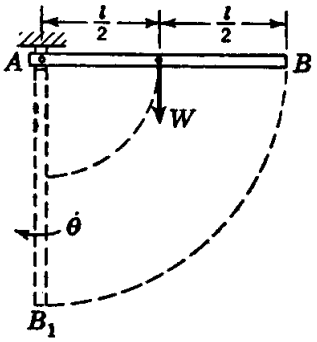


Fig. 8

63. The angular velocity of a gear is controlled according to $\omega = 12\text{-}3t^2$ where ω is in radians per second and is positive in the clockwise sense and where t is the time in seconds. Find the net angular displacement $\Delta\theta$ from the time t=0 to t=3 s. Also find the total number of revolutions N through which the gear turns during the 3 secs.

64. If the slender prismatic bar in fig 9 is released from rest in the horizontal position AB and allowed to fall under the influence of gravity, what angular velocity $\dot{\theta}$ will it acquire by the time it reaches the vertical position AB?



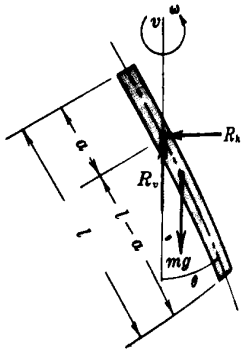


Fig. 9 Fig 10

Problems on Inertia Force, D'Alembert's Principle

65. A uniform bar of length l and mass m is rotating at a constant angular velocity ω about a vertical axis through a point at a distance 'a' from one end. For the phase shown in fig 10 when the bar is passing through the plane of the paper, determine the horizontal and vertical components of the reaction of the support on the bar.

66. A pendulum of length l and weight w is supported from the ceiling of an elevator. How will its period of oscillation for small amplitudes be affected by a constant upward or downward acceleration 'a' of the elevator?

67. Find the maximum acceleration along a level road that the rear wheel drive automobile shown in fig can attain if the coefficient of friction between tyres and pavement is μ.

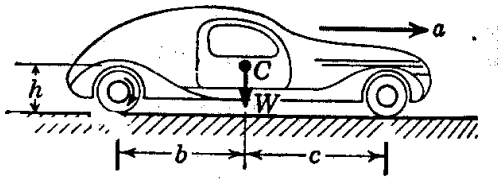


Fig. 11

68. A particle of weight W attached to a fixed point o by a string of length l whirls in a horizontal cirular path of radius r with uniform speed v so that the string generates a cone of height $h=(l^2-r^2)^{1/2}$. Determine the relation between v, r and h and also the tensile force S in the string during such motion.

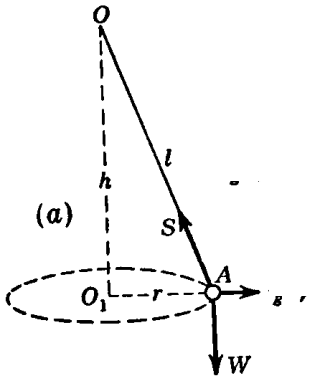


Fig. 12

69. Referring to the below given figure, determine the so called superelevation e of the outer rail on a railroad curve of radius r so that a car travelling at speed v around the curve will exert equal pressures on the two rails. The distance between rails is b as shown.

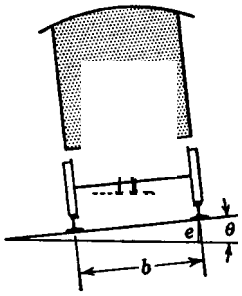


Fig. 13

70. Assume that the disk in the fig.14 rolls without slipping. Determine the tensions in the ropes and the acceleration of the mass centre of disk A.

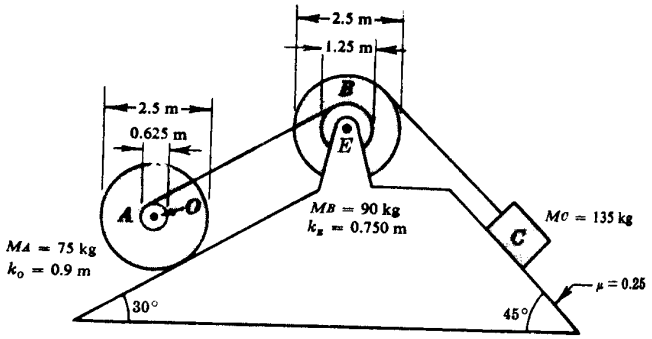


Fig. 14

Problems on Principle of Work and Energy, Conservation of Energy

71. Block A initially rests on the spring to which it is connected by a 600 mm inextensible cord which becomes taut after the system is released. What will be the stretch of the spring to bring the system to rest? The cylinder may be considered homogeneous, has a mass of 75 Kg, and rotates in frictionless bearings. Refer to the below fig. 15.

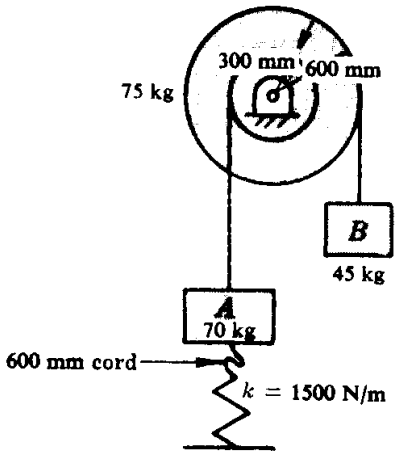
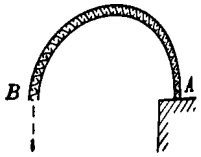


Fig 15

72. A smooth semicircular tube AB of radius r is fixed in a vertical plane and contains a heavy flexible chain of length πr and weight wπr as shown in fig.16 assuming a slight disturbance to start the chain in motion, find the velocity, v with which it will emerge from the open end B of the tube.

Fig. 16



73. A glass U-tube having a uniform bore of cross sectional area A is open at both ends and contains a column of liquid of total length l and specific weight w as shown in fig. Using the law of conservation of energy, find the period t of free oscillations after being disturbed from its equilibrium position as shown in Fig.17 Neglect friction between the fluid and the walls of the tube.

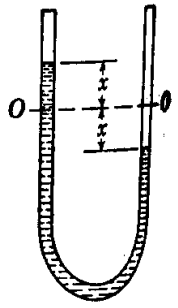
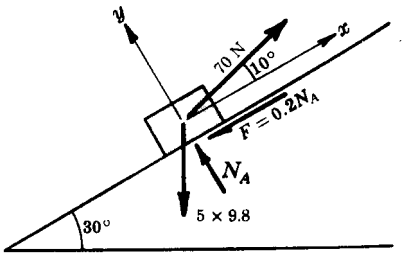


Fig. 17

74. Find the work done in rolling a 20kg [illegible] up a plane inclined 30° with the horizontal as shown in Fig. 18. Assume a coefficient of friction 0.25.

Fig. 18



75. A cylinder is pulled up a plane by the tension in a rope which passes over a frictionless pulley and is attached to a 70 kg mass as shown in fig. The 45 kg cylinder has radius 600 mm. The cylinder moves a distance of 5 m. What will be its speed?

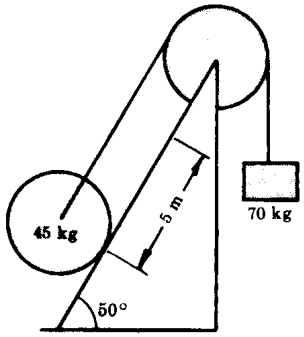


Fig. 19

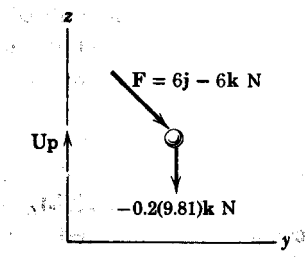
76. Determine the speed of escape, i.e. the initial speed which must be given to a particle on the earth's surface to project it to an infinite height.

77. A slender rod 2 m long and having a mass of 4 kg increases its speed about a vertical axis through one end from 20 rpm to 50 rpm in 10 revolutions. Find the constant moment M required to do this.

Problems on Principle of impulses and momentum

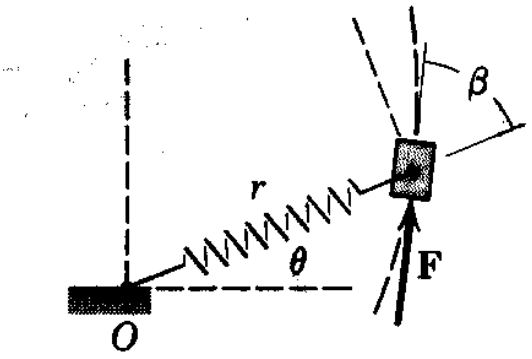
78. A 0.2 kg particle moves in the vertical y-z plane (z up, y horizontal) under the action of its weight and a force f which varies with the time. The linear momentum of the particle in N-s is given by the expression $G=3/2(t^2+3)j -2/3(t^3-4)k$ where t is the time in seconds. Determine F for the instant when t= 2s.

Fig 20



79. The small 2 kg block slides on a smooth horizontal surface under the action of the force in the spring and a force F. The angular momentum of the block about O varies with time as shown in the graph. When t=6.5 s, it is known that r=150 mm and β=60°. Determine F for this instant.

Fig. 21



80. The force P which is applied to the cable wrapped around the central hub of the symmetrical wheel, is increased slowly according to P=6.5t, where P is in Newtons and t is in seconds after P is first applied. Determine the angular velocity ω of the wheel 10 s after P is applied if the wheel is rolling to the left with a velocity of its centre of 0.9 m/s at time t=0. The wheel which has a mass of 60 kg and radius of gyration about its centre of 250 mm, rolls without slipping.

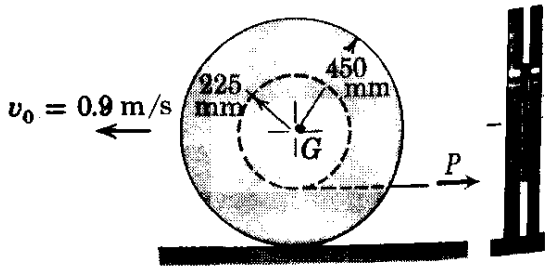


Fig. 22

81. A spring normally 150 mm long is connected to the two masses shown in fig.26 and compressed 50mm. If the system is released on a smooth horizontal plane, what will be the speed of each block when the spring is again in its normal length? The spring constant is 2100 N/m.

82. Fig. 23

83. A rocket and its fuel have an initial mass m_o. Fuel is burned at a constant rate, dm/dt=C. The gases exhaust at a constant speed relative to the rocket. Neglecting air resistance, find the speed of the rocket at time t.

Multiple Choice Questions on Statics

1. A number of forces acting at a point will be in equilibrium if
   (a) their total sum is zero
   (b) two resolved parts in two directions at right angles are equal
   (c) sum of resolved parts in any two perpendicular directions are both zero
   (d) all of them are inclined equally
   (e) none of the above

2. Two non-collinear parallel equal forces acting in opposite direction
   (a) balance each other
   (b) constitute a moment
   (c) constitute a couple
   (d) constitute a moment of couple
   (e) constitute a resultant couple

3. If a rigid body is in equilibrium under the action of three forces, then
   (a) these forces are equal
   (b) the lines of action of these forces meet in a point
   (c) the lines of action of these forces are parallel
   (d) (b) and (c) of the above
   (e) none of the above

4. The centre of gravity of a uniform lamina lies at
   (a) the centre of heavy portion
   (b) the bottom surface
   (c) the mid point of its axis
   (d) all of the above
   (e) none of the above

5. Centre of gravity of a solid cone lies on the axis at the height
   (a) one-fourth of the total height above base
   (b) one-third of the total height above base
   (c) one-half of the total height above base
   (d) three-eighth of the total height above the base
   (e) none of the above

6. M. I. Of a thin circular ring of radius r and mass M about an axis perpendicular to plane of ring is
   (a) Mr^2
   (b) $\pi r^4/2$
   (c) $2/5\ Mr^2$
   (d) $2/3Mr^2$
   (e) $Mr^2/2$

7. In the equation of virtual work, following forces are neglected
   (a) reaction of any smooth surface with which the body is in contact
   (b) reaction of a rough surface of a body which rolls on it without slipping
   (c) reaction at a point or an axis, fixed in space, around which a body is constrained to turn
   (d) all of the above
   (e) none of the above

8. The coefficient of friction depends on
   (a) area of contact
   (b) shape of surfaces
   (c) strength of surfaces
   (d) nature of surfaces
   (e) all of the above

9. The ratio of limiting friction and reaction is known as
   (a) coefficient of friction
   (b) angle of friction
   (c) angle of repose
   (d) sliding friction

(e) friction resistance

10. Frictional force encountered after commencement of motion is called
    (a) post friction
    (b) limiting friction
    (c) kinematic friction
    (d) frictional resistance
    (e) dynamic friction

11. Coefficient of friction is the
    (a) angle between normal reaction and the resultant of normal reaction and the limiting friction
    (b) ratio of limiting friction and normal reaction
    (c) the friction force acting when the body is just about to move
    (d) the frictional force acting when the body is in motion
    (e) tangent of angle of repose

12. A body of weight W on inclined plane of α being pulled up by a horizontal force P will be on the point of motion up the plane when P is equal to
    (a) W
    (b) $W\sin(\alpha + \phi)$
    (c) $W \tan(\alpha + \phi)$
    (d) $W \tan(\alpha - \phi)$
    (e) $W \tan\alpha$

13. Kinetic friction is the
    (a) tangent of angle between normal reaction and resultant of normal reaction and the limiting friction
    (b) ratio of limiting friction and normal reaction
    (c) the friction force acting when the body is in motion
    (d) the friction force when the body is just about to move
    (e) dynamic friction

14. A single force and a couple acting in the same plane upon a rigid body
    (a) balance each other
    (b) cannot balance each other
    (c) produce moment of a couple
    (d) are equivalent
    (e) none of the above

15. The maximum frictional force which comes into play when a body just begins to slide over another surface is called
    (a) limiting friction
    (b) sliding friction
    (c) rolling friction
    (d) kinematic friction
    (e) dynamic friction

16. Which of the following is the locus of a point that moves in such a manner that its distance from a fixed point is equal to its distance from a fixed line multiplied by a constant greater than one
    (a) ellipse
    (b) hyperbola
    (c) parabola
    (d) circle
    (e) none of the above

17. The C. G. of a solid hemisphere lies on the central radius
    (a) at distance 3r/2 from the plane base
    (b) at distance 3r/4 from the plane base
    (c) at distance 3r/5 from the plane base
    (d) at distance 3r/8 from the plane base
    (e) at distance r/2 from the plane base

18. The C. G. of a trapezium of base 'b', height 'h' and upper side 'a' lies at following distance from the base
    (a) (h/3) {(2a+b)/(a+b)}

(b) (h/3) {(a+b)/(2a+b)}
(c) (h/3) {(a+2b)/(a+b)}
(d) (h/2) {(2a+b)/(a+b)}
(e) (h/4) {(2a+b)/(a+b)}

19. The C. G. of an isosceles triangle with base'a' and other sides 'b' lies at following distance from the base
(a) $\sqrt{(4a^2-b^2)}/6$
(b) $\sqrt{(a^2-b^2)}/6$
(c) $\sqrt{(2a^2-b^2)}/6$
(d) $\sqrt{(a^2-2b^2)}/6$
(e) $\sqrt{(4a^2-b^2)}/3$

20. According to theorem of perpendicular axes, if I_{xx} and I_{yy} be the M. I. Of a lamina about xx and yy axes then M. I. Of the lamina about axis zz which is perpendicular to xx and yy equal to
(a) $I_{xx}+I_{yy}$
(b) $I_{xx}.I_{yy}$
(c) I_{xx}/I_{yy}
(d) I_{yy}/I_{xx}
(e) $\sqrt{(I_{xx}^2+I_{yy}^2)}$

21. The C.G. of a plane lamina will not be at its geometrical centre in case of a
(a) right angled triangle
(b) equilateral triangle
(c) square
(d) circle
(e) rectangle

22. M. I. Of a rectangular area of base 'b' and height 'd' about x axis is given by
(a) $bd^3/3$
(b) $bd^3/4$
(c) $bd^3/6$
(d) $bd^3/12$
(e) $bd^3/8$

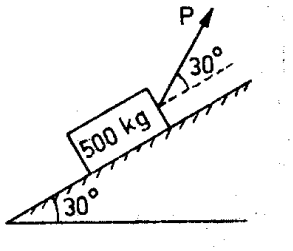
23. The C.G. of a right circular solid cone of height 'h' lies at the following distance from the base
(a) h/2
(b) h/3
(c) h/6
(d) h/4
(e) 3h/5

24. M. I. Of circular area whose diameter is 'd' about an axis perpendicular to the area passing through its centre is given by
(a) $\pi d^4/64$
(b) $\pi d^4/32$
(c) $\pi d^4/12$
(d) $\pi d^4/16$
(e) $\pi d^4/24$

25. M.I of a hollow circular section about a central axis perpendicular to the section as compared to its M.I. about horizontal axis is
(a) same
(b) double
(c) half
(d) four times
(e) one-fourth

26. M. I. Of a triangle of base 'a' and height 'h' about the base is given by
(a) $ah^3/6$
(b) $ah^3/12$
(c) $ah^2/6$
(d) $ah^2/12$
(e) $ah^3/3$

27. A weight of 500 kg is held on a smooth plane, inclined at 30° to the horizontal by a force P acting 30° above the planer as shown in Fig . The reaction of the plane on the weight will be
    (a) 500 kg
    (b) 250 kg
    (c) 476 kg
    (d) 288 kg
    (e) none of the above



Multiple Choice Questions on Mechanics of Materials

1. Longitudinal Strain is defined as the ratio of

   i. change in volume to original volume
   ii. change in length to original length
   iii. change in cross sectional area to original cross sectional area
   iv. none of the above.

2. Hook's Law is valid upto

   i. yield point
   ii. limit of proportionality
   iii. breaking point
   iv. elastic limit
   v. plastic limit

3. Young's modulus is defined as the ratio of

   i. volumetric stress and volumetric strain
   ii. lateral stress and lateral strain
   iii. longitudinal stress and longitudinal strain
   iv. shear stress and shear strain
   v. longitudinal stress ands lateral strain

4. If equal and opposite force applied to a body tend to elongate it, the stress produced is

   i. internal resistance
   ii. tensile stress
   iii. transverse stress
   iv. compressive stress
   v. working stress

5. The material having same elastic properties in all directions are called

   i. ideal material
   ii. uniform material
   iii. isotropic material
   iv. elastic material
   v. none of the above

6. Modulus of rigidity is defined as the ratio of

   i. longitudinal stress and longitudinal strain
   ii. volumetric stress and volumetric strain
   iii. lateral stress and lateral strain
   iv. shear stress and shear strain
   v. linear stress ands lateral strain

7. The impact strength of a material is an index of its

   i. toughness
   ii. tensile strength
   iii. capability of being cold worked
   iv. hardness
   v. fatigue strength

8. The property of a material by virtue of which a body returns to its original shape after removal of the load is called
   i. plasticity
   ii. elasticity

iii. ductility
iv. malleability
v. resilience

9. The property of a material which allows it to be drawn into a smaller section is called

i. plasticity
ii. elasticity
iii. ductility
iv. malleability

10. Poisson's ratio is defined as

i. longitudinal stress and longitudinal strain
ii. longitudinal stress and lateral stress
iii. lateral stress and longitudinal stress
iv. lateral stress ands lateral strain
v. none of the above

11. The energy absorbed by a body , when it is strained within the elastic limit, is known as

i. strain energy
ii. resilience
iii. proof resilience
iv. modulus of resilience
v. toughness

12. The maximum strain energy that can be stored in a body is known as

i. impact energy
ii. resilience
iii. proof resilience
iv. modulus of resilience
v. toughness

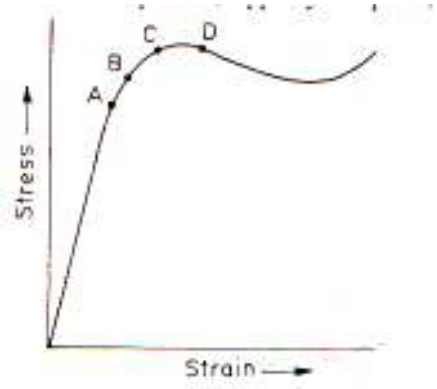
13. The total strain energy stored in a body is termed as

i. resilience
ii. proof resilience
iii. modulus of resilience
iv. toughness

14. Proof resilience per unit volume of a material is known as
i. resilience
ii. proof resilience
iii. modulus of resilience
iv. toughness

38. If I_x and I_y be the moment of inertia about any two axes at right angles to each other in the plane of the area and intersecting at the pole , then the polar moment of inertia I_p will be
i. $I_x + I_y$
ii. $(I_x + I_y)/2$
iii. $I_x \times I_y$
iv. $(I_x + I_y)^{1/2}$
v. $\int I_x \times I_y$

39. The following figure shows the stress-strain diagram for mild steel. The elastic limit, upper yield point, lower yield point and proportional limit are represented by



i. A,B,C,D
ii. A,C,D,B
iii. B,C,D,A
iv. C,B,D,A
v. B,C,A,D

Multiple Choice Questions on Kinematics and Kinetics

1. The weight of a body is due to
   (a) centripetal force of the earth
   (b) gravitational pull exerted by the earth
   (c) forces experience by body in atmosphere
   (d) force of attraction experienced by particles
   (e) gravitational force of attraction towards the centre of the earth.

2. When trying to turn a key into a lock the following is applied
   (a) coplanar force
   (b) non-coplanar forces
   (c) lever
   (d) moment
   (e) couple

3. Which of the following do not have identical dimensions?
   (a) Momentum and impulse
   (b) Torque and energy
   (c) Torque and work
   (d) Kinetic energy and potential energy

4. According to principle of transmissibility of forces, the effect of a force upon a body is
   (a) maximum when it acts at the centre of gravity of a body
   (b) different at different points in its line of action
   (c) the same at every point in its line of action
   (d) minimum when it acts at the C.G. of the body
   (e) none of the above.

5. The magnitude of two forces, which when acting at right angle produce resultant force of $\sqrt{10}$ kg and when acting at 60^o produce resultant of $\sqrt{13}$ kg. These forces are
   (a) 2 and $\sqrt{6}$ kg
   (b) 3 and 1
   (c) $\sqrt{5}$ and $\sqrt{5}$
   (d) 2 and 5
   (e) none of the above

6. According to law of triangle of forces
   (a) three forces acting at a point will be in equilibrium
   (b) three forces acting at a point can be represented by a triangle, each side being proportional to the force
   (c) if three forces acting upon a particle are represented in magnitude and direction by the sides of a triangle, taken in order, they will be in equilibrium
   (d) if three forces acting at a point are in equilibrium, each force is proportional to the sine of the angle between the other two
   (e) none of the above

7. D' Alembert's principle is used for
   (a) reducing the problem of kinetics to equivalent statics problem
   (b) determining stresses in the truss
   (c) stability of floating bodies
   (d) designing safe structures
   (e) solving kinematic problems.

8. Two coplanar couples having equal and opposite moments
   (a) balance each other
   (b) produce a couple and an unbalanced force
   (c) are equivalent
   (d) produce a moment of couple
   (e) cannot balance each other.

9. The centre of percusion of a homogeneous rod of length L suspended at the top will be
   (a) L/2
   (b) L/3

(c) 3L/4
(d) 2L/3
(e) 3L/8

10. A rope is wrapped twice around a rough pole with a coefficient of friction μ. It is subjected to a force F_1 at one end. A gradually increasing force F_2 is applied at the other end till the rope just starts slipping. At this instant the ratio of F_2 to F_1 is
    (a) 1
    (b) $e^{4\pi\mu}$
    (c) $e^{2\mu}$
    (d) $e^{\mu 360}$
    (e) none of the above

11. The centre of percussion of a solid cylinder of radius r resting on a horizontal plane will be
    (a) r/2
    (b) 2r/3
    (c) r/4
    (d) 3r/2
    (e) 3r/4

12. On a ladder resting on smooth ground and leaning against vertical wall, the force of friction will be
    (a) towards the wall at its upper end
    (b) away from the wall at its upper end
    (c) upwards at its upper end
    (d) downwards at its upper end
    (e) none of the above

13. The velocity of a body on reaching the ground from a height h, is given by
    (a) $v = 2gh$
    (b) $v = 2gh^2$
    (c) $v = \sqrt{(2gh)}$
    (d) $v = 1/\sqrt{(2gh)}$
    (e) $v = h^2/(2g)$

14. If rain is falling in the opposite direction of the movement of a pedestrian, he has to hold his umbrella
    (a) more inclined when moving
    (b) lesss inclined when moving
    (c) more inclined when standing
    (d) less incline when standing
    (e) none of the above

15. Cartesian equation of a trajectory is
    (a) $y = x\sin\alpha - gx^2/(2u^2\sin^2\alpha)$
    (b) $y = x\tan\alpha - gx^2/(2u^2\tan^2\alpha)$
    (c) $y = x\tan\alpha - gx^2/(2u^2\cos^2\alpha)$
    (d) $y = x\tan\alpha + gx^2/(2u^2\cos^2\alpha)$
    (e) $y = x\tan\alpha + gx^2/(2u^2\sin^2\alpha)$

16. A projectile is fired at an angle θ to the vertical. Its horizontal range will be maximum when θ is
    (a) 0^o
    (b) 30^o
    (c) 45^o
    (d) 60^o
    (e) 90^o

17. if the velocity of projection is u m/sec and the angle of projection is α^o, the maximum height of the projectile on a horizontal plane is
    (a) $u^2\cos^2\alpha/(2g)$
    (b) $u^2\sin^2\alpha/(2g)$
    (c) $u^2\tan^2\alpha/2g$
    (d) $u^2\sin^2\alpha/g$
    (e) $u\sin\alpha/g$

18. Two bodies of 100 kg and 400 kg are resting on two inclined planes α and β towards each other and the bodies are joined together by a string passing over a pulley connected at the top of inclined planes. Coefficient of friction for two bodies with their inclined planes are μ_1 and μ_2. Tension in string will be
    (a) 100 kg
    (b) 300 kg
    (c) 400 kg
    (d) 500 kg
    (e) 600 kg

19. The effort required to be applied parallel to plane, to move a body of weight W upon rough inclined plane (μ = coeff. Of friction = tanφ) with inclination α to horizontal is
    (a) W$\tan\alpha$
    (b) W $\tan(\alpha + \phi)$
    (c) W $\tan(\alpha - \phi)$
    (d) W$(\sin\alpha + \mu\cos\alpha)$
    (e) W$(\cos\alpha + \mu\sin\alpha)$

20. The effort required to lift a load w on a screw jack with helix angle α and angle of friction ϕ is equal to
    (a) W$\tan(\alpha + \phi)$
    (b) W$\tan(\alpha - \phi)$
    (c) W$\cos(\alpha + \phi)$
    (d) W$\sin(\alpha + \phi)$
    (e) W$(\sin\alpha + \cos\phi)$

21. A particle inside a hollow sphere of radius r, having coefficient of friction $1/\sqrt{3}$ can rest upto a height of
    (a) r/2
    (b) r/4
    (c) r/8
    (d) 0.134r
    (e) 3r/8

22. The algebraic sum of moments of the forces forming couple about any point in their plane is
    (a) equal to the moment of the couple
    (b) constant
    (c) both the above statements are correct
    (d) both the above statements are wrong
    (e) none of the above

23. If three forces acting in one plane upon a rigid body, keep it in equilibrium, then they must either
    (a) meet in a point
    (b) be all parallel
    (c) at least two of them must meet
    (d) all the above are correct
    (e) none of the above

24. A body moves from rest with a constant acceleration of 5 m/sec. The distance covered in 5 sec is most nearly

    (a) 38 m
    (b) 62.5 m
    (c) 96 m
    (d) 124 m
    (e) 240 m

25. A flywheel on a motor goes from rest to 1000rpm in 6 sec. The number of revolutions made is nearly equal to
    (a) 25
    (b) 50
    (c) 100
    (d) 250
    (e) 500

26. The angle which an inclined plane makes with the horizontal when a body placed on it is about to move down is known as angle of
    (a) friction
    (b) limiting friction
    (c) repose
    (d) kinematic friction
    (e) static friction

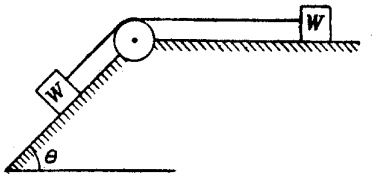
27. The minimum coefficient of friction between a sphere and inclined plane of θ, so that the sphere may roll without slipping is
    (a) $\tan\theta$
    (b) $1/2\tan\theta$
    (c) $2/7\ \tan\theta$
    (d) $1/7\ \tan\theta$
    (e) $3/7\ \tan\theta$

28. A ladder resting against a wall will never slip irrespective of where man stands on it, if the ladder makes an angle
    (a) not greater than friction angle with vertical
    (b) equal to friction angle with vertical
    (c) greater than friction angle with vertical
    (d) any angle irrespective of friction angle
    (e) none of the above

29. A locomotive of weight W is pulled by a force P just equal to the total friction at the points of contact A and B. The vertical reaction R_A and R_B respectively will be
    (a) $W/2 + Pb/(2a)$, and $W/2 - Pb/(2a)$
    (b) W/2 each
    (c) $W/2 - Pb/(2a)$, and $W/2 + Pb/(2a)$
    (d) $W/2 + Pb/(2a)$ each
    (e) $W/2 - Pb/(2a)$ each

30. A rectangular block of width w and height h is resting on a horizontal floor. It is to be avoided from overturning when a horizontal pull acts at any height on the block. This will be possible when
    (a) $w/h>\mu$
    (b) $w/h<\mu$
    (c) $w/(2h)> \mu$
    (d) $w/(2h)< \mu$

31. Two rectangular blocks of weight W each are connected by a flexible cord and rest upon a horizontal and an inclined plane with the cord passing over a pulley as shown in Fig. If μ is the coefficient of friction for all contiguous surfaces, angle θ for motion of system to impede will be
    (a) $\tan\theta = \mu$
    (b) $\tan(\theta/2) = \mu$
    (c) $\tan 2\theta = \mu$
    (d) $\tan\theta = 2\mu$
    (e) $\tan\theta = \mu/2$.



Fig

32. A circular disc of weight W rolls down an inclined plane of inclination θ. If force of friction be F, then the total net force on the disc parallel to plane is equal to
    (a) $W - F\sin\theta$

(b) Wsinθ - F
(c) Wcosθ - F
(d) Fcosθ - W
(e) Wtanθ - F

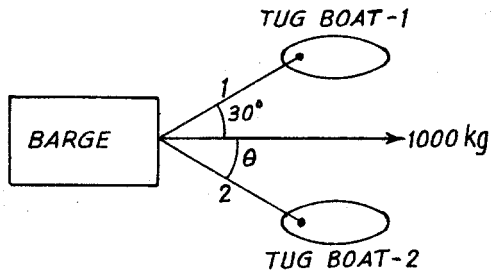
33. A body is resting on a plane inclined at angle of 30° to horizontal. What force would be required to slide it down, if the coefficient of friction between body and plane is 0.3
(a) zero
(b) 1 kg
(c) 5 kg
(d) would depend on weight of body
(e) none of the above

34. Least force that starts a body along a plane acts at an angle with the plane
(a) equal to the angle of friction
(b) little more than angle of friction
(c) little less than angle of friction
(d) of zero degree
(e) none of the above

35. A body weighing 100 kg falls vertically down on a cart weighing 200 kg moving at velocity V m/sec. The velocity of cart after falling of weight would be
(a) V m/sec
(b) More than V m/sec
(c) Less than V m/sec
(d) Unpredictable
(e) None of the above

36. A freight car weighing 50,000 kg is moving with a velocity of 1 m/sec when it strikes a bumping post. If the draw bar spring on the car takes all the compression, and the deflection is not to be more than 10 cm, then scale of spring should be approximately equal to
(a) $50x10^4$ kg/cm
(b) $100x10^4$ kg/cm
(c) $25x10^4$ kg/cm
(d) $250x10^4$ kg/cm
(e) none of the above

37. A barge is pulled by two tugboats as shown in Fig. The resultant of the forces exerted by the tugboats is 1000 kg force. What will be the value of θ so that tension in the rope 2 is minimum?
(a) 30°
(b) 45°
(c) 60°
(d) 0°
(e) 90°



Fig

38. If a mass of 20 kg falling from a height of 1.0 m from rest is brought to rest by penetrating into sand by 1 m, then average resistance offered by sand is
    (a) 100 kg
    (b) 110 kg
    (c) 150 kg
    (d) 200 kg
    (e) 50 kg

39. An elevator weighing 1000 kg attains an upward velocity of 4 m/sec in two sec with uniform acceleration. The tension in the supporting cables will be
    (a) 1000 kg
    (b) 800 kg
    (c) 1200 kg
    (d) 2000 kg
    (e) not possible to determine

40. When a body slides down an inclined surface, the acceleration (f) of the body is given by
    (a) f=g
    (b) f=gsinθ
    (c) f = gcosθ
    (d) f = gtanθ
    (e) f = g/(sinθ)

41. A particle while sliding down a smooth plane of 19.86 √2 m length acquires a velocity of 19.86 m/sec. The inclination of plane is
    (a) 30^o
    (b) 45^o
    (c) 60^o
    (d) 75^o
    (e) none of the above.

42. A jet engine works on the principle of conservation of
    (a) energy
    (b) mass
    (c) angular momentum
    (d) linear momentum
    (e) none of the above

43. If the momentum of abody is doubled, its kinetic energy will
    (a) increase by 2 times
    (b) increase by four times
    (c) remain same
    (d) get halved
    (e) reduce to one fourth

44. If a particle moves along the circumference of a circle of radius 'r' with a uniform angular velocity ω radians/sec, the equation for the velocity of the particle is given by
    (a) $v = \omega\sqrt{(y^2 - r^2)}$
    (b) $v = \omega\sqrt{(y - r)}$
    (c) $v = \omega\sqrt{(r^2 - y^2)}$
    (d) $v = \omega\sqrt{(r^2 + y^2)}$
    (e) none of the above

45. The kinetic energy of a body rotating with an angular speed ω depends on
    (a) ω only
    (b) ω^2 only
    (c) its mass only
    (d) the distribution of mass and angular speed
    (e) all of the above

46. If two bodies, one light and the other heavy, have equal kinetic energy, which one has a greater linear momentum
    (a) the heavy body

(b) the light body
(c) both have equal momentum
(d) upredictable
(e) none of the above statements is correct.

ME 201 : Mechanical Sciences(Second Semester)
Contact : 3L
Credit : 3
Assuming 14 weeks available,
No. of periods : 14 x 3 = 42

Sl. No.	Topics to be covered	Assigned Lectures	Recommended Text Book

West Bengal University of Technology

BF-142, Salt Lake City, Kolkata-700064

Syllabus of First Year

(Common to All Branches of B.Tech Programme)

upto 2006

	A. THERMODYNAMICS		Engineering Thermodynamics by P.K. Nag (2nd Edition) :
1.	Introduction to Thermodynamics, Concepts of systems, control volume, state, properties, equilibrium, quasi-static process, reversible & irreversible process, cycles.	2	Art : 1.1, 1.2, 1.3, 1.4, 1.5, 1.6 P: 1.5, 1.8, 1.9 + problems solved. Q : 1.1 to 1.5
2.	Zeroeth Law and Temperature, Ideal Gas	1	Art : 2.1, 2.2, 2.6, 2.7 P : 2.3, 2.5 + problems solved. Q : 2.1 to 2.4, 2.13, 2.16
3.	Heat and Work	1	Art : 3.1, 3.2, 3.7, 3.8 P : 3.4, 3.5, 3.13, 3.15 + solved problems. Q : 3.1 to 3.7, 3.14 to 3.19
4.	Real gases, Equations of State, Processes of Ideal Gases. Law of Corresponding States	3	Art : 10.2, 10.3, 10.4, 10.5, 10.6, 10.7 P : 10.3, 10.7, 10.8, 10.9, 10.17 (entropy related parts to be done later) + solved problems Q : 10.1, 10.3, 10.5 to 10.7, 10.12, 10.13, 10.16, 10.17, 10.18, 10.31, 10.38
5.	(i) 1st Law of Thermodynamics for closed & open systems (ii) Non Flow Energy Equation (iii) Steady State, Steady Flow Energy Equation	3	Art : 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.9, 5.1, 5.2, 5.3, 5.4 P : 4.3, 4.5, 4.8, 4.13, 4.14 + solved problems Q : 4.1, 4.5, 4.6, 4.8 P: 5.1, 5.2, 5.3, 5.4 Q : 5.2, 5.3, 5.4
6.	2nd Law of Thermodynamics – Statements, Equivalence of two statements, Definition of Heat Engines, Heat pumps, Refrigerators	2	Art : 6.1, 6.2, 6.3, 6.4, 6.5, 6.6 P : 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8 + solved problems Q : 6.2, 6.10, 6.12 to 6.18
7.	Carnot Cycle; Carnot efficiency, Concept of absolute temperature, Thermodynamic scale of temperature	2	Art : 6.10, 6.11, 6.12, 6.13, 6.14, 6.15, 6.16 P : 6.9, 6.10, 6.13, 6.15 + solved problems. Q : 6.35, 6.41, 6.42, 6.43

8	Clausius inequality, Entropy and irreversibility.	2	Art : 7.3, 7.4, 7.5, 7.6, 7.7 P : 7.1, 7.2, 7.3, 7.4, 7.5, 7.16 + solved problems Q : 7.3 to 7.7
9	Properties of Pure Substances – Use of Steam Tables and Mollier Charts	3	Art : 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7, 9.8 P : 9.1, 9.2, 9.3, 9.4, 9.5, 9.6 + solved problems Q : 9.1, 9.2, 9.3, 9.4, 9.5
10	Air Standard cycles – Otto and Diesel cycle and their efficiencies	4	Art : 13.4, 13.5, 13.6 P : 13.4, 13.6, 13.7, 13.8, 13.9 + solved problems Q : 13.5, 13.7
11	Steam Power Cycle – Rakine cycle, p-v & T-S plots, Rankine efficiency	2	Art : 12.1, 12.2 P : 12.1 Q : 12.1, 12.2, 13.3, 12.4
12	Vapur compression refrigeration cycle	1	Art : 14.3 No problems. Q : 14.1, 14.2
		Total = 26	
	B. FLUID MECHANICS		Introduction to Fluid Mechanics & Fluid Mechines (2nd Edition) by S.K. Som & G. Biswas
1.	Properties & Classification of Fluids – ideal & real fluids, Newton's law of viscosity, Newtonian & Non Newtonian Fluids, Compressible & Incompressible fluids	3	Art : 1.1, 1.2, 1.3, 1.4, 1..4.1 to 1.4.9 Exercises : 1.1, 1.2, 1.3, 1.4, 1.5, 1.6 Solved Examples (relevant)
2.	Fluid Statics : Pressure at a point, Pascal's law. Measurement of Pressure : Use of manometers : U-tube, inclined tube, micro-manometers.	3	Art : 2.1, 2.2, 2.3, 2.4, 2.5, 2.6 Exercises : 2.1, 2.2, 2.3, 2.4, 2.5 Solved Examples (relevant)
3.	Fluid Kinematics : Steady & unsteady flow. Uniform & non-uniform flow. Stream line, path line, streak line. Continuity equation.	3	Art : 3.1, 3.2, 3.3, 3.3.1 to 3.3.3, 4.1, 4.2, 4.2.1 Exercises : 3.1, 3.2, 3.3, 3.4, 3.5 Solved Examples 3.1, 3.2, 3.3, 3.4, 3.5
4.	Dynamics of ideal fluids : Bernoulli's equation, total head, velocity head, pressure head. Application of Bernoulli's equation	4	Art : 4.5, 4.6, 4.6.1, 4.6.2 Exercises : 4.1 Solved Examples : 4.9, 4.10, 4.11
5.	Measurement of flow rate : Venturimeter, pitot tube, orificemeter.	3	Art : 5.7, 5.8, 5.8.1 Exercises : 5.1, 5.11 to 5.15 Solved Examples: 5.7, 5.8, 5.11, 5.12
		Total = 16	

Total = 42

The students should attempt solving the problems as indicated against each topic of the Recommended Books.
Books: Fundamentals of Mechanical Sciences, Bhattacharya & Mukhopadhyay,Pearson Education.

ME 192 : WORKSHOP PRACTICAL(First Semester)

Contacts : 3P
Credits : 2
Assuming 12 weeks : 12 x 3 = 36 Periods

1. Carpentry (Wood Working)
Timber, Seasoning and Preservation, Plywood and Plyboards, Carpentry Tools, Engineering applications. Different Joints

2. Metal Joining

Definitions of welding, brazing and soldering processes, and their applications. Oxy-acetylene gas welding process, equipment and techniques. Types of flames and their applications. Manual metal arc welding technique and equipment.
AC and DC welding, electrodes, constituents and functions of electrodes. Welding positions. Types of weld joint. Common welding defects such as cracks, slag inclusion and porosity.

3. Bench work and Fitting

Tools for laying out, chisels, files, hammers, hand hacksaw, their specifications and uses.

4. Jobs to be made in the Workshop

Group A

T-Lap joints and Bridle joint (Carpentry Shop) 12P

Group B

1a. Gas Welding practice on mild steel flat/sheet upto 3mm thick
1b. Lap joint by Gas Welding (upto 3mm thick)
1c. Manual Metal Arc Welding practice (upto 5mm thick) 15P
1d. Square butt joint by MMA Welding
1e. Lap joint by MMA Welding

Group C

Laying out (bench work); Sawing and Finishing by Filing. 9P

36P

 # Before practice, background lectures will be delivered on the topics. Tool specifications and their materials will be described. Brief reports on the work done will be submitted by the students and evaluation will be made on the basis of examination of the report and viva, conducted by the teachers.

Recommended Books

1. M.L. Begeman and B.H. Amstead, “Manufacturing Process” John Wiley, 1968

2. W.A.J. Chapman and E.Arnold, "Workshop Technology" Vol. 1, 2 & 3
3. B.S. Rghuwanshi, "Workshop Technology" Vol. 1 & 2 – Dhanpt Rai and Sons.
4. S.K.Hajra Choudhury, "Elements of Workshop Technology" Media Promoters of Publishers
5. Khanna, O.P. "Workshop Technology" Dhanpat Rai Publications
6. S.Crawford "Basic Engineering Processes" Hodder & Stoughton

ME 292 : WORKSHOP PRACTICAL(Second Semester)

Contacts : 3P
Credits : 2
Assuming 14 weeks : 14 x 3 = 42 Periods

1. Metal Cutting

Introduction to machining and common machining operations. Cutting tool materials, geometry of cutting tool, cutting fluid. Definition of machine tools, specification and block diagram of lathe, shaper, milling, drilling machine and grinder. Common lathe operations such as turning, facing and chamfering and parting. Difference between drilling and boring. Use of measuring instruments like micrometer / vernier caliper.

2. Tin Smithy – Surface development,
Shearing and Bending of sheets, Making simple products by Tin Smithy practice.

3. Brazing – Basic Process of Brazing

4. Jobs to be made in the Workshop

Group A

1) Jobs on lathe with turning, facing, chamfering and parting operations		15P
2) Job on shaper and milling machine for finishing two sides of a job	12P	
3) Drilling of holes of size 5 and 12 mm diameters on the jobs / External threads making by dies, Tap size drill hole/ hand tapping operations		3P

Group B

Demonstration of brazing	3P	

Group C

Tin Smithy - making simple products on sheet metal	9P	
		42P

Before practice, background lectures will be delivered. Brief Reports on the work done will be submitted by the student. Evaluation will be done on the basis of reports and viva-voce examinations conducted by the teachers.

Recommended Books

1. M.L. Begeman and B.H. Amstead, "Manufacturing Process" John Wiley, 1968
2. W.A.J. Chapman and E.Arnold, "Workshop Technology" Vol. 1, 2 & 3
3. B.S. Rghuwanshi, "Workshop Technology" Vol. 1 & 2 – Dhanpt Rai and Sons.
4. S.K.Hajra Choudhury, "Elements of Workshop Technology" Media Promoters of Publishers
5. Khanna, O.P. "Workshop Technology" Dhanpat Rai Publications
6. S.Crawford "Basic Engineering Processes" Hodder & Stoughton

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ME 101 : Mechanical Sciences
Contact : 3L + 1T = 4
Credit : 4

Introduction to Statics: Fundamental idealization: Particle and Rigid body concept; Types of forces (collinear, concurrent, parallel, concentrated, distributed), Vector and scalar quantities, Transmissibility of a force (sliding vector); Lami's Theorem.
Introduction to Vector Algebra, Vector Operations, Parallelogram law, Free vector, Bound Vector; representation of Forces and Moments in terms of i,j,k; Cross product and Dot product and their applications.
Two and three dimensional force systems; Moment and Couple, Varignon's theorem, Resultants, Free body concept. Resolution of a coplanar force by its equivalent Force-couple system. Concept of Equilibrium in Two and Three dimensions. Equations of Equilibrium.
Concept of Friction; Laws of Coulomb friction, Angle of Repose.
Distributed Force: Centroid and Centre of Gravity, Moments of inertia of plane figures : M.I. of plane figures : MI of plane figure with respect to an axis in its plane; MI of plane figure with respect to an axis perpendicular to the plane of the figure, Parallel axis theorem; Mass moment of inertia of symmetrical bodies, e.g. cylinder, sphere, rod.
Principle of virtual work with simple application.
Concept of simple stresses and strains: Normal stress, Shear stress, Bearing stress, Normal strain, Shearing strain, Hooke's law, Poisson's ratio, Examples.
Stress and strains under axial loading stress-strain diagram of ductile materials, Working stress, Factor of safety, Proportional limit, Elastic Limit, Ultimate stress, Yielding, Modulus of elasticity, Definitions of malleability, ductility, toughness and resilience. Concept of thermal stress.
Introduction to Dynamics: Kinematics and Kinetics; Rectilinear motion of particles; determination of position velocity and acceleration – under uniform rectilinear motion (uniform and nonuniform accelerated rectilinear motion), Relative motion, construction of x-t, v-t and a-t graphs (simple problems).
Plane curvilinear motion of particles: Rectangular components (Projectile motion), Normal and Tangential components, Radial and Transverse components, simple problems.
Plane kinematics of Rigid bodies: Translation and Rotation.
Kinetics of particles : Rectilinear motion of particles; Plane kinetics of Rigid bodies : Rectilinear motion. Equation of motion, D.Alembert's principle.
Principle of work and energy applied to particle and rigid bodies, Principle of conservation of energy, Power and efficiency, simple examples.
Principle of Linear Impulse and Momentum .

Books Recommended

1. Engineering Mechanics [Vol-I & Vol-II] by Mariam & Kraige
2. Elements of Strength of Materials by Timo Shenko & Young
3. Strength of Materials by S. Ramamruthan
4. Mechanics for Engineering by Beer, F.P. and Johnston
5. Mechanics of Engineers (Statics) by Ferdinand P.Beer & E. Russel Johnston Jr.
6. Mechanics of Engineers (Dynamics) by Ferdinand P.Beer & E. Russel Johnston Jr.
7. Mechanics for Materials by Ferdinand P.Beer & E. Russel Johnston Jr.
8. Engineering Mechanics by Irvin L. Shames
9. Engineering Mechanics by Timo Shenko & Young

ME 201 : Mechanical Sciences
Contact : 3L
Credit : 3

A. THERMODYNAMICS

Introduction to Thermodynamics, Concepts of systems, control volume, state, properties, equilibrium, quasi-static process, reversible & irreversible process, cycles.
Zeroeth Law and Temperature, Ideal Gas.
Heat and Work.
Real gases, Equations of State, Processes of Ideal Gases. Law of Corresponding States.
1st Law of Thermodynamics for closed & open systems. Non Flow Energy Equation. Steady State, Steady Flow Energy Equation.
2nd Law of Thermodynamics – Statements, Equivalence of two statements, Definition of Heat Engines, Heat pumps, Refrigerators.
Carnot Cycle; Carnot efficiency, Concept of absolute temperature, Thermodynamic scale of temperature.
Clausius inequality, Entropy and irreversibility.
Properties of Pure Substances – Use of Steam Tables and Mollier Charts.

Air Standard cycles – Otto and Diesel cycle and their efficiencies.
Steam Power Cycle – Rakine cycle, p-v & T-S plots, Rankine efficiency.
Vapur compression refrigeration cycle.

B. FLUID MECHANICS

Properties & Classification of Fluids – ideal & real fluids, Newton's law of viscosity, Newtonian and non-Newtonian fluids, Compressible and Incompressible fluids.
Fluid Statics : Pressure at a point, Pascal's law.
Measurement of Pressure : Use of manometers : U-tube, inclined tube, micro-manometers.
Fluid Kinematics : Steady and unsteady flow. Uniform & non-uniform flow. Stream line, path line, streak line. Continuity equation.
Dynamics of ideal fluids : Bernoulli's equation, total head, velocity head, pressure head. Application of Bernoulli's equation.
Measurement of flow rate : Venturimeter, pitot tube, orificemeter.
Books Recommended

1. Engineering Thermodynamics by P K Nag.
2. Thermodynamics by C P Arora.
3. Fundamentals of Classical Thermodynamics by G J Van Wyle and R E Santag
4. Introduction to Fluid Mechanics and Fluid Machines by S.K.Som and G.Biswas.
5. Fluid Mechanics by V L Streeter and E B Wylie.
6. Fluid Mechanics and Hydraulic Machines by R K Bansal.
7. Fluid Mechanics by A.K.Jain.

ME 191 : ENGINEERING GRAPHICS
Contacts : 3P
Credits : 2
Assuming 12 weeks : 12 x 3 = 36 Periods

		Periods [Inclusive Lecture]
1. LINES, LETTERING, DIMENSIONING, COPYING FIG.	6(1L)	
2. SCALES Plain scales, Diagonal scales, Comparative scales, Vernier scales		6(2L)
3. GEOMETRICAL CONSTRUCTION AND CURVES Dividing of lines and angles in equal sectors, Construction of polygons, Polygons inscribed in circles, Parabola, Hyparabola, Ellipse, Cycloid, Involute, Archemedian spiral	6(2L)	
4. PROJECTION OF POINTS, LINES, SURFACES Orthographic Projection – First angle and third angle projection More no. of problems should be practiced in first angle projection. Projection of lines inclined to the planes Projection of surfaces Pentagon, Hexagon	9(3L)	
5. PROJECTION OF SOLIDS Cube, Pyramid, Prism, Cylinder, Cone, Frustums	9(2L)	

		36P

Home Assignments to be given to the student to supplement the sessional work. Students should attempt to solve the problems given in the question bank (Problem Sheet). Evaluation will be made on the basis of drawing sheets submitted and viva-voce examination conducted by the teacher.

Recommended Books

1. Narayana, K.L. and Kannaiah, P "Engineering Graphics" Tata Mcgraw Hill

2. Bhatt, N.D. "Elementary Engineering Drawing" Charotar book stall, Anand 1998
3. Lakshminaarayanan, V and Vaish Wanar, R.S. "Engineering Graphics" Jain Brothers, New Delhi
4. Chandra, A.M. and Chandra Satish, "Engineering Graphics" Narosa, 1998

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ME 291 : ENGINEERING GRAPHICS

Contacts : 3P

Credits : 2

Assuming 14 weeks : 14 x 3 = 42 Periods

		Periods [Inclusive of Lectures]
1. ISOMETRIC VIEW AND ISOMETRIC PROJECTION (Prism, Pyramid, Cylinder, Cone and examples of simple solid objects / models).	6(2L)	
2. SECTIONAL VIEWS OF SOLIDS, TRUE SHAPE OF A SECTION Home assignments will be given.	6(1L)	
3. RIVET HEADS, RIVETED JOINTS (Rivet heads, types, lap-joint, butt joint - single / double cover)	3(1L)	
4. THREADS, NUT-BOLT (BSW and Metric threads, hexagonal and square headed bolts/nuts.)	6(2L)	
5. DEVELOPMENT OF SURFACES (Cube, Prism, Cylinder, Truncated Cone) Home assignment will be given to the student.	3(1L)	
6. INTERPENETRATION OF SURFACES (Intersecting cylinders, Intersection of Cone and cylinder, Intersection of two prisms)	6(2L)	
7. MACHINE PARTS		6P
8. COMPUTER AIDED DRAFTING (AutoCAD) Introduction : Cartesian and Polar Co-ordinate system, Absolute And Relative Co-ordinates; Basic editing Commands : Line, Point, Trace, Rectangle, Polygon, Circle, Arc, Ellipse, Polyline; Basic editing Commands : Basic Object Selection Methods, Window and Crossing Window, Erase, Move, Copy, Offset, Fillet, Chamfer, Trim, Extend, Mirror ; Display Commands : Zoom, Pan, Redraw, Regenerate; Simple dimensioning and text, Simple exercises.	6(2L)	

		42P

Sessional work should be completed in the class. Problems sheet will be provided.
Home assignments will be given. Evaluation will be made on the basis of sessional work and viva-voce examination.

Recommended Books :

1. Bhatt N.D. “Elementary Engineering Drawing”, Anand’98
2. French and Vireck, “The Fundamental of Engineering Drawing and Graphic Technology”, McGraw Hill, 4th Ed.,1978
3. ‘IS:696 (1972) Code of Practice for General Engineering Drawing”, ISI New Delhi
4. P.S. Gill, “A Text Book of Machine Drawing”, Katson Publishing House
5. Giesecke, Mitchell, Spener, Hill and Dygon, “Technical Drawing”, McMillan & Co., 7th Ed. 1980
6. George Omura, “Mastering AUTOCAD”, B.P.B. Publication, New Delhi, 1994
7. Venugopal K. : Engineering Drawing & Graphics + Auto CAD, New Age International

8. Venugopal K. : Engineering Graphics, New Age International

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ME 192 : WORKSHOP PRACTICAL

Contacts : 3P

Credits : 2

Assuming 12 weeks : 12 x 3 = 36 Periods

1. Carpentry (Wood Working)

Timber, Seasoning and Preservation, Plywood and Plyboards, Carpentry Tools, Engineering applications. Different Joints

2. Metal Joining

Definitions of welding, brazing and soldering processes, and their applications. Oxy-acetylene gas welding process, equipment and techniques. Types of flames and their applications. Manual metal arc welding technique and equipment.
AC and DC welding, electrodes, constituents and functions of electrodes. Welding positions. Types of weld joint. Common welding defects such as cracks, slag inclusion and porosity.

3. Bench work and Fitting

Tools for laying out, chisels, files, hammers, hand hacksaw, their specifications and uses.

4. Jobs to be made in the Workshop

Group A

T-Lap joints and Bridle joint (Carpentry Shop) 12P

Group B

1a. Gas Welding practice on mild steel flat/sheet upto 3mm thick
1b. Lap joint by Gas Welding (upto 3mm thick)
1c. Manual Metal Arc Welding practice (upto 5mm thick) 15P
1d. Square butt joint by MMA Welding
1e. Lap joint by MMA Welding

Group C

Laying out (bench work); Sawing and Finishing by Filing. 9P

36P

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7. W.A.J. Chapman and E.Arnold, "Workshop Technology" Vol. 1, 2 & 3
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9. S.K.Hajra Choudhury, "Elements of Workshop Technology" Media Promoters of Publishers
10. Khanna, O.P. "Workshop Technology" Dhanpat Rai Publications
6. S.Crawford "Basic Engineering Processes" Hodder & Stoughton

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ME 292 : WORKSHOP PRACTICAL

Contacts : 3P

Credits : 2

Assuming 14 weeks : 14 x 3 = 42 Periods

1. Metal Cutting

Introduction to machining and common machining operations. Cutting tool materials, geometry of cutting tool, cutting fluid. Definition of machine tools, specification and block diagram of lathe, shaper, milling, drilling machine and grinder. Common lathe operations such as turning, facing and chamfering and parting. Difference between drilling and boring. Use of measuring instruments like micrometer / vernier caliper.

2. Tin Smithy – Surface development,
Shearing and Bending of sheets, Making simple products by Tin Smithy practice.

3. Brazing – Basic Process of Brazing

4. Jobs to be made in the Workshop

Group A

1) Jobs on lathe with turning, facing, chamfering and parting operations		15P
2) Job on shaper and milling machine for finishing two sides of a job	12P	
3) Drilling of holes of size 5 and 12 mm diameters on the jobs / External threads making by dies, Tap size drill hole/ hand tapping operations		3P

Group B

Demonstration of brazing	3P	

Group C

Tin Smithy - making simple products on sheet metal	9P	
		42P

Before practice, background lectures will be delivered. Brief Reports on the work done will be submitted by the student. Evaluation will be done on the basis of reports and viva-voce examinations conducted by the teachers.

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8. W.A.J. Chapman and E.Arnold, "Workshop Technology" Vol. 1, 2 & 3
9. B.S. Rghuwanshi, "Workshop Technology" Vol. 1 & 2 – Dhanpt Rai and Sons.
10. S.K.Hajra Choudhury, "Elements of Workshop Technology" Media Promoters of Publishers
11. Khanna, O.P. "Workshop Technology" Dhanpat Rai Publications
12. S.Crawford "Basic Engineering Processes" Hodder & Stoughton