



## 4.1

## SOLID MECHANICS

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### RATIONALE

Diploma holders in this course are required to analyse reasons for failure of different components and select the material for different applications. For this purpose, it is essential to teach them concepts, principles, applications and practices covering stress, strain, bending moment, shearing force, shafts, columns and springs. Hence this subject has been introduced.

### DETAILED CONTENTS

1. **Introduction to Material Properties** (3 Periods)  
Mechanical properties of materials such as elasticity, plasticity, ductility, brittleness, toughness, hardness, tenacity, fatigue, malleability, stiffness. Elastic bodies, plastic bodies and rigid bodies, deformation.
2. **Stresses and Strains** (10 Periods)
  - 2.1 Force, its definition and types, units, different types of loads.
  - 2.2 Definition of stress and strain, axial loading, different types of stresses and strains, tensile and compressive stress and strain, elastic limit, Hooke's law, stress-strain curve for ductile and brittle material, salient features of stress-strain curve. Young's modulus of elasticity
  - 2.3 Factor of safety, safe stresses, ultimate stress
  - 2.4 Stress and strain in straight, stepped bars and taper bar of circular cross section, determination of stress and elongation of a bolt in a bolted joint when subjected to direct external load only
  - 2.5 Temperature stresses for single section.
  - 2.6 Stress and strain on composite section under axial loading, stress and strain due to temperature variations in homogeneous and composite bars and metallic tyres
  - 2.7 Shear load, shear stress and strain, modulus of rigidity, lateral strain, Poisson's ratio
  - 2.8 Volumetric strain, bulk modulus. relation between modulus of elasticity, modulus of rigidity and bulk modulus
3. **Shear Force and Bending Moment** (18 Periods)
  - 3.1 Types of beams and types of supports
  - 3.2 Concept of shear force and bending moment, sign convention
  - 3.3 Shear force and bending moment diagram for cantilever and simply supported beams subjected to point load and uniformly distributed loads only. Maximum bending moment and point of contraflexure



## संयुक्त प्रवेश परीक्षा एवं प्रशिक्षण, अनुसंधान विकास प्रकोष्ठ देहरादून उत्तराखण्ड

4. **Theory of Simple Bending** (14 Periods)
  - 4.1 Concept of pure bending, neutral axis, moment of resistance, section Modulus, bending equation, bending of simple and flitched beams, beams of uniform strength
  - 4.2 Application of flexural formula for solid rectangular and circular section, Channel section, hollow rectangular and circular section
5. **Strain Energy** (6 Periods)
  - 5.1 Concept of strain energy, proof resilience and modulus of resilience
  - 5.2 Stresses developed due to gradual, sudden and impact load
  - 5.3 Strain energy stored due to gradual, sudden and impact load
  - 5.4 Strain energy due to bending and torsion
6. **Slope and Deflection** (10 Periods)
  - 6.1 Introduction, determination of slope and deflection by Macaulay's method, moment area of method
  - 6.2 Simple cases of slope and deflection in simply supported beam with uniformly distributed load on whole of the length and a point load at the centre
  - 6.3 Cantilever beam with uniformly distributed load on whole length and a point load at the end (no derivation of formula)
7. **Torsion** (9 Periods)
  - 7.1 Pure torsion, torsion equation (relation between twisting moment, shear stress and angle of twist), polar modulus of section
  - 7.2 Assumptions in theory of pure torsion
  - 7.3 Strength of circular solid shaft and hollow shaft in pure torsion
  - 7.4 Power transmitted by shaft
  - 7.5 Torsion in helical springs
8. **Springs** (5 Periods)
  - 8.1 Laminated spring (semi-elliptical and quarter-elliptical type), determination of number of plates, maximum deflection under axial load
  - 8.2 Helical Springs closed coiled and open coiled helical springs subjected to axial load
  - 8.3 Angle of twist, strain energy, shear stress and maximum deflection under axial load
  - 8.4 Effect of falling load helical spring



## 9. Columns and struts

(5 Periods)

- 7.1 Definition, Types of column
- 7.2 Buckling load, crushing load
- 7.3 Slenderness ratio.
- 7.4 Factors affecting strength of column
- 7.5 Euler's formula for long columns
- 7.6 End restraints, effective length for different end conditions
- 7.7 Rankine Gourdan formula
- 7.8 Direct and eccentric loading with stress diagram
- 7.9 Direct and bending stresses and their combination

### LIST OF PRACTICALS

- Perform tensile test on bars of mild steel .
- Perform shear test on specimen of two different metals.
- Carry out bending tests on a steel bar or wooden beam.
- Perform following impact test:
  - Izod impact test
  - Charpy test
- Perform torsion test on specimen of different metals for determination of angle of twist for a given torque.
- Determine the stiffness of a helical spring and to plot a graph between load and extension.
- Perform hardness test on metal and finding the Brinell hardness and Rockwell hardness.

### INSTRUCTIONAL STRATEGY

- Use computer based learning aids for effective teaching-learning
- Expose the students to real life problems.
- Plan assignments so as to promote problem solving abilities and develop continued learning skills.

### RECOMMENDED BOOKS

- Strength of Materials by R.S. Khurmi; S. Chand and Company, Delhi.
- Strength of Materials by S. Ramamurtham; Dhanpat Rai Publishing Co.(P) Limited, Delhi.
- Mechanics of Materials by Kirpal Singh; Standard Publishers, New Delhi.
- Elements of Strength of Materials by D.R. Malhotra and H.C, Gupta; Satya Parkashan, New Delhi.
- Mechanics of Solids by VS Prasad; Galgotia Publications, New Delhi.



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Strength of materials Dr. B.C Puniya & S.Rama Murthi; Laxmi Publication, New Delhi.

Mechanics of solids by J.K.Kapoor; Bharat Bharati Prakashan, Meerut

**SUGGESTED DISTRIBUTION OF MARKS**

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1.	3	3
2.	10	12
3.	18	23
4.	14	18
5.	6	7
6.	10	12
7.	9	11
8.	5	7
9.	5	7
Total	<b>80</b>	<b>100</b>



## 4.2 CONSTRUCTION MATERIALS & CONSTRUCTION TECHNOLOGY

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5 - 3

### RATIONALE

Materials play an important role in construction of farm structures . Right selection of materials adds to the life of structures. A diploma holder must be conversant with properties, uses and other aspects of different building materials and construction technologies should be able to estimate the cost of the proposed building /structure.

### DETAILED CONTENTS

1. Materials (18 Periods)
  - 1.1 Stone: Formation of Rocks, classification of rocks quarrying of stones, characteristics & uses of granite, sand stone, lime stone, marble & slate.
  - 1.2 Bricks: Characteristics, classification as per ISI, special types of Bricks, fire bricks, surkhi bricks, ballast, and general idea of tiles
  - 1.3 Lime: Slaking of lime, commercial names, its classification, characteristics, storage, precautions handling & uses of lime.
  - 1.4 Cement: Natural and artificial cement, characteristics of cement, type of cement, their properties and uses, Method of storage.
  - 1.5 Timber: Definition, types of hardwood, softwood, objects of timber seasoning of timber, water seasoning, and kiln seasoning. Preservation of timber, market form of timber, brief study of common Indian timbers- plywood, hardboard and pattern board (only properties and uses).
  - 1.6 Types, characteristics & uses of following Building Materials (No manufacture)
    - a) Stones
    - b) Bricks
    - c) Lime
    - d) Cement
    - e) Timber
    - f) Paints & Varnishes
    - g) Hardware
    - h) Plastics
2. Engineering Materials (12 Periods)
  - 2.1 Ferrous Metals:  
Classification of iron
    - a) Cast iron: Types as per BIS their properties and uses
    - b) Classification according to carbon contents and as per BIS, properties of various steel and uses



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- a) Alloy steel: Effects of various alloying elements. Properties of common steel, alloy steel.
  - 2.2 Paints and Varnishes: Objects of paints and varnishes, types of paints, characteristics, selection of paints, storage of paints. Types of varnishes, characteristics and uses of varnishes
  - 2.3 Plastics: Polymers and various composite materials, classification, properties and uses - linoleum, plastic coated paper, polythene sheets, thermocolel and PVC.
3. **Construction Methods** (08 Periods)
- 3.1 Introduction
  - 3.2 Foundation: Constructional details of spread footing (thumb rule only).
  - 3.3 Stone Brick masonry: Study of various types of bricks bonds
  - 3.4 Damp proof course: Materials used.
  - 3.5 Doors and windows: types and uses of doors, windows and ventilators.
  - 3.6 Plastering and Pointing: Types and methods
  - 3.7 Concrete:
    - d) Lime concrete: Ingredient, specifications, preparation and uses.
    - e) Cement concrete: Ingredient preparation, laying, compaction curing, and uses of local materials as farm work, application of Ferro cement
  - 3.8 Lintels: Wooden, RCC and RB lintels.
  - 3.9 Floors: Common types, construction, methods, drainage and cleaning of floors
  - 3.10 Roofs: Roofing materials and timber trusses/sheds for cattle and work places.



4. **Rural Construction** (06 Periods)

- 4.1 Rural buildings :Cattle shed ,barns ,poultry house ,grain bin and go downs-  
their construction details ,capacity and functional requirement
- 4.2 Rural sanitation: Constructional details of septic tank, soakpit, aqua-privy  
and PRAI latrines.
- 4.3 Farm Road: kachcha road, tar McAdam and pakka road.
- 4.4 Rural drainage: Specification as per BIS standard
- 4.5 Rural water supply: Construction and working of India mark II pump.  
overhead tank and laying of pipelines .

**LIST OF PRACTICALS**

1. Identification of different types of stones.
2. Identification of different types of timber.
3. To conduct field test of cement.
4. To determine normal consistency of cement.
5. To determine setting time of cement (a) Initial setting time (b) Final setting time.
6. To determine water absorption of bricks.
7. To determine compressive strength of bricks.
8. To determine fineness of cement by sieve method.
9. To make brick bonds (English and Flemish bond only).
10. To visit construction sites and write specific report about following activities:  
Earth work in foundation, flooring, plactering, pointing, whitewashing and colour  
washing. And installation of India mark II pump and laying of water pipe line.

**RECOMMENDED BOOKS**

1. Building Materials by Parbin Singh
2. Text Book of Engineering Materials by DS Arora, Kalyani Publications, New  
Delhi
3. Engineering Materials by SC Rangwala, Charotar Publications, Anand, Gujrat
4. Engineering Materials by Sushil Kumar, Metropolitan Books, Delhi
5. Estimation and costing by B.N Dutta



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**SUGGESTED DISTRIBUTION OF MARKS**

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	18	23
2	12	15
3	18	23
4	12	15
5	20	25
<b>Total</b>	<b>80</b>	<b>100</b>

SUGGESTION





# संयुक्त प्रवेश परीक्षा एवं प्रशिक्षण, अनुसंधान विकास प्रकोष्ठ देहरादून उत्तराखण्ड

## 4.3

## WATERSHED & FOREST MANAGEMENT

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4 - 2

### RATIONALE

A diploma holder in Agricultural Engineering needs to learn about the watershed management & forest management. A course on watershed shall equip the students with the knowledge of the various watershed technologies and its use in forest management. This course will educate about poly house and other protected cultivation.

#### 1- Introduction(5periods)

Watershed, watershed development, management, stream order, planning, watershed delineation.

#### 2- PRA, watershed committees, SHGs, problems of watershed, factors affecting watershed. (5 periods)

#### 3- Watershed evaluation, monitoring, GIS and remote sensing and its applications in watershed management. (5periods)

#### 4-Protected cultivation – What and Why in Agriculture (5 periods)

#### 5- Protected cultivation Technologies –Raised bed cultivation, mulching, low tunnel and micro irrigation, green house. (3 periods)

#### 6-Forest Ecology and Its Significance. (3 periods)

#### 7-Forest Survey and Mapping. (3 periods)

#### 8-Forest Recreation / Ecotourism.(3Periods)

#### 9-Community Forestry (4Periods)

#### 10-Biodiversity Conservation(4 Periods)

#### 11-Forest Monitoring and Surveillance(4 Periods)

### PRACTICALS

#### 1- Study of watershed characteristics

#### 2- Delineation of watershed

#### 3- Study of various watershed management technologies.

#### 4- Preparing watershed plan on map.

#### 5- Study of forest survey.

#### 6- Study tour to nearest national park.



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## RECOMMENDED BOOKS

1. watershed Planning and management – Rajvir Singh, Yash Publishing House
2. Hydrology and Soil Conservation Engineering – Ghanshyam Das, Prentice Hall
3. Remote Sensing and Image Interpretation, Lille Sand and Kaiffer R., John Willey and Sons
4. Principles of geographical information systems for land resources assessment- P. A. Burrough
5. Davis,L.S.; Johnson,N.K. 1987 ,Forest Management ,McGrawhill Book Company, New York
6. Recknagel,A.B.; Bentley,J. 1985 ,Forest Management ,International Book Distributors, Dehra Dun
7. Gupta,M.D.; Gangopadhyay,A.K.; Bhattacharya,T.; Chalraborti,M. (Eds.) 1986 Forestry Development in North East India ,Omsons Publications, Guwahati
8. shah,S.A. 1988 ,Forestry for People ,Indian Council of Agricultural Research, New Delhi

## SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	5	10
2	5	10
3	5	10
4	5	10
5	3	9
6	3	8
7	3	8
8	4	8
9	4	9
10	4	9
11	4	9
	45	100



#### 4.4

#### BASIC ELECTRICAL AND ELECTRONICS TECHNOLOGY

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5 - 3

#### RATIONALE

The objective of the course is to impart basic knowledge and skills regarding electrical and electronics engineering, which diploma holders will come across in their professional life

#### DETAILED CONTENTS

- 1. Overview of Electricity:** (04 Periods)  
General use and applications of electricity; Use and applications of electricity to agriculture; Advantages of electrical energy over other forms of energy.
- 2. DC Circuits:** (10 Periods)  
Introduction to basic terms: charge, current, voltage, power, and energy; Ohm's law; Power dissipation in resistors; Series and parallel combination of resistors; Kirchhoff's laws; Star-delta conversions; Thevenin's theorem, Norton's theorem, and Maximum-power-transfer theorem; Ideal and practical voltage source; Current source.
- 3. AC Circuits:** (14 Periods)  
Concept of alternating voltage and current; Introduction to basic terms: cycle, frequency, time period, amplitude, instantaneous value, rms value, peak value, phase difference, form factor, and peak factor; Concept of phasor; Phasor diagrams; Concepts of reactance, impedance, admittance, susceptance, and conductance; Concepts of instantaneous power, real power, reactive power, apparent power, complex power, and power factor; Analysis of simple AC circuits; Overview of three-phase AC circuits.
- 4. Batteries and Solar Cells:** (08 Periods)  
Primary and secondary cells; Construction, working, and applications of Lead-Acid; Charging methods for Lead-Acid batteries; Maintenance of Lead-Acid batteries; Series and parallel connection of batteries; Maintenance free batteries; General idea of solar cells, solar panels and their applications.
- 5. Electrical Machines:** (16 Periods)



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Electromagnetic induction; Introduction to magnetic circuits; Principles of electromechanical energy conversion; Construction and operation of single phase transformers; Tests of transformers; Efficiency and regulation; Operation of autotransformers & welding transformer;. Types of three-phase induction motors; principle of operation.; Methods of starting and speed-control of three-phase induction motors; Overview of single-phase induction motors.; Construction and operation of synchronous machines; Construction and operation of stepper motors. Applications of single and three phase induction motors.

## **. Semiconductors:** (10 Periods)

Classification of materials as conductors, insulators, and semiconductors; Intrinsic and extrinsic semiconductors; p-type and n-type semiconductors; pn-junction diode; Half wave and full wave rectification using diodes; Basic construction and operation of BJT, UJT, JFET, MOSFET, and thyristor.

## **7. Measuring Instruments:** (10 Periods)

Construction and working principles of PMMC and MI type voltmeters and ammeters; Dynamometer wattmeter; Induction-type energy meters; Measurement of power and energy in three-phase circuits; Use of digital meters (voltmeter, ammeter, and multimeter).

## **8. Electrical Installation and Safety:** (08 Periods)

Various accessories and parts of electrical installation; Overview of industrial and domestic wiring systems; Common electrical safety measures; Protection and precaution against electrical shock; Treatment of electrical shock; Basic protective devices like fuse, MCB, thermal overload relay, ELCB, and RCCB; Concepts and types of earthing; Protection against lightning.

## **LIST OF PRACTICALS**

Verification of Ohm's Law

Verification of KCL and KVL

Test of charging and discharging of lead-acid battery using hydrometer

Connection of a three-phase motor and starter with fuses and reversing of direction

Connection of analog and digital single phase energy meter

Study of a distribution board for domestic and industrial installation

Open-circuit and short-circuit test on a single-phase transformer

Star-delta starting of induction motors

To draw V-I characteristics of pn-junction diode



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To draw input and output characteristics of a transistor in CB and CE configurations

## RECOMMENDED BOOKS

1. Basic Electrical Engineering by PS Dhongal; Tata McGraw Hill Publishers, New Delhi
2. Basic Electricity by BR Sharma; Satya Prakashan, New Delhi
3. Electrical Machines by SK Bhattacharya; Tata McGraw Hill, New Delhi
4. Experiments in Basic Electrical Engineering by SK Bhattacharya and KM Rastogi, New Age International Publishers Ltd., New Delhi

## SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	4	5
2	10	13
3	14	16
4	8	10
5	16	20
6	10	13
7	10	13
8	8	10
<b>Total</b>	<b>80</b>	<b>100</b>



#### 4.5

#### FARM MACHINE DRAWING

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- - 6

#### RATIONALE

Diploma Holders are required to read and interpret drawings. Therefore it is essential that they have competency in preparing drawings and sketches of various machine parts. Therefore this subject is essentially required.

#### DETAILED CONTENT

##### 1. Introduction

- Limits and Fits: Limit system – tolerance, limits, deviation, allowance, basic size, design size. Tolerances-fundamental tolerances, fundamental deviation, method of placing limit dimensions.

Fits: Clearance fit, transition fit, interference fit, hole basis system, shaft basis system, tolerance grades.

Calculating values of clearance/interference, hole tolerance and, shaft tolerance with given basic size for common assemblies like H7/g6, H7/m6, H8/u7.

##### Surface Roughness

Introduction-actual profile, reference profile, datum profile, mean profile, peak-to-valley height, mean roughness index, surface roughness number.

Use of machining symbols in production drawings, indication of surface roughness-indication of special surface roughness characteristics, indication of machining allowance, indication of surface roughness, symbols on drawings, method of indicating surface roughness on given components.

Indicating roughness on a component for: -

1. Surface to be obtained by any production method.
2. Surface to be obtained without removal of material.

##### 2. Shaft Couplings

(2 sheets)

- Oldham coupling



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- Universal coupling
3. Bearings (5 sheets)
- Bush bearing
  - 1. Foot step bearing 16
- Plummer block
4. Pipe Joints (3 sheets)
- Symbols for piping and layout plan of piping
  - Flanged joint
  - Socket and spigot joint
  - Union joint
5. Screw Jack (1 sheet)
6. Shovel and Sweeps of cultivators (1 sheet)
7. Seed metering devices like fluted rollers, cup feed type and inclined plate type. (1 sheet)
8. Mould board and disk plough components (2 sheets)
9. Sectional view of hand pumps. (1 sheet)

## RECOMMENDED BOOKS

- Machine Drawing by P.S. Gill; S.K. Kataria and Sons, Delhi.  
Machine Drawing by R.K. Dhawan; S. Chand and Company, Delhi.  
Machine Drawing by R.B. Gupta; Satya Parkashan, New Delhi.  
Elements of Agriculture Engg.  
Machine Drawing by N.D. Bhatt; Charotar Publishing House.





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**Note:**

1. The drawings should include dimensions with tolerances, wherever necessary, and material list according to B.I.S. specifications as per SP46: 1988.
2. 25% of the drawing sheets should be drawn using AutoCAD.

SUGGESTION





#### 4.6 OPERATION & MAINTINANCE OF TRACTOR AND FARM MACHINES

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- - 6

##### RATIONALE

This is a practice-oriented subject, which will create the ability and develop the skill to carry out different agricultural operations for raising the crops using tractors and matching farm equipment. It will also enable the students to handle and operate the machines and implements used for crop production and carry out the minor repair and adjustments of machines for effective and efficient machinery usage.

##### DETAILED CONTENTS

1. Familiarization with different gauges and controls of tractors, pre operational checks and precautions
2. Tractor driving practices without implements in limited space like L shape, Circle, “8” etc.
3. Tractor trolley reversing in limited space and turning .
4. Operation of primary tillage equipment in field. Controlling the speed of operation, gear selection, adjustments in the machine for different operations
5. Operation of secondary tillage equipment, seed bed preparation, gear selection, adjustments in machine desired results.
6. Operation of sowing and planting equipment, gear selection, adjustments in the machine for proper seed placement, calibration for proper seed and fertilizer application and care of machines.
7. Operating various plant protection equipment, adjustments, nozzle calibration, and care of equipment and precautions
8. Familiarization of power tillers and their controls, operations of equipment with power tillers with care of machines and precautions.
9. Measurement of speed, slip, draft, field efficiency, field capacity & fuel consumption of tractor during field operations.



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### 4.7 INDUSTRIAL TRAINING

Industrial training provides an opportunity to students to experience the environment and culture of industrial production units and commercial activities undertaken in field organizations. It prepares student for their future role as diploma engineers in the world of work and enables them to integrate theory with practice.

For this purpose, students at the end of fourth semester need to be sent for industrial training for a minimum of 4 weeks duration to be organised during the semester break starting after IV Semester examinations. The concerned HODs along with other teachers will guide and help students in arranging appropriate training places relevant to their specific branch. It is suggested that a training schedule may be drawn for each student before starting of the training in consultation with the training providers. Students should also be briefed in advance about the organizational setup, product range, manufacturing process, important machines and materials used in the training organization.

Equally important with the guidance is supervision of students training in the industry/organization by the teachers. A teacher may guide a group of 4-5 students. A minimum of one visit by the teacher is recommended. Students should be encouraged to write daily report in their diary to enable them to write final report and its presentation later on.

Internal assessment and external assessment have been provided in the study and evaluation scheme of V Semester. Evaluation of professional industrial training report through viva-voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations. The formative and summative evaluation may comprise of weightage to performance in testing, general behaviour, quality of report and presentation during viva-voce examination. It is recommended that such evaluations may be carried out by a team comprising of concerned HOD, teachers and representative from industry, if any. The components of evaluation will include the following.

a) Punctuality and regularity	15%
b) Initiative in learning new things	15%
c) Relationship with workers	15%
d) Industrial training report	55%