Motor Vehicle Science

Part 1

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P. W. Kett

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To my wife I dedicate this book. Her forbearance,
help and understanding over the past two years made
the book possible.

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The alpha-numeric code which appears after the entries refers to the TEC U77/413 and 415 Motor Vehicle Science II and III Model Programmes of Study.

Preface

A motor vehicle technician has to attain high technological skills to enable him or her to diagnose faults and service modern transport vehicles and their components.

Science is a branch of study concerned with the systematic investigation of observed facts, and forms an important foundation on which to build sound engineering practice. Such a background will stimulate personal development by increasing confidence and intellectual ability. This is the first of two books planned to cover the TEC U77/413 and 415 Motor Vehicle Science II and III Model programmes of study. Part 1 is intended to cover the requirements of Motor Vehicle Science II. The fundamental principles of engineering science have been applied to the motor vehicle in a systematic and progressive manner to enable the reader to follow most of the work on his or her initiative. The book is aimed mainly at the student who is attending a recognized college course leading to a Technician qualification. The importance of the college lecturer and his individual method of teaching the subject remains of prime importance to the student. The book is designed to become a valid source of information to assist the student both in and out of the classroom environment to attain his or her objective.

Numerous fully worked and exercise examples are given. Plenty of practice in solving problems is an excellent way to gain knowledge of the subject, and improve confidence in preparation for an examination.

The signs and symbols used in this book will be repeated where applicable in Part 2, thus the reader can become conversant with them and recognize their meaning immediately. All the SI symbols and abbreviations used are the official ones.

Filby
Norfolk

P.W.K.

Nomenclature

The following is a list of abbreviations and symbols used in the book.

<i>A</i>	area (m^2)
<i>a</i>	acceleration (m/s^2)
ACW	anti-clockwise
BDC	bottom dead centre
bhp	brake horse power
BM	bending moment (N m)
bmep	break mean effective pressure (N/m^2)
<i>c</i>	specific heat capacity ($\text{J}/(\text{kg } ^\circ\text{C})$) or ($\text{J}/(\text{kg K})$)
CF	centrifugal force (N)
CG	centre of gravity
CI	compression ignition
CP	circular pitch
CSA	cross-sectional area (m^2)
CV	calorific or heat value (J/kg)
CW	clockwise
<i>D</i>	diameter (m)
<i>d</i>	diameter (m) or relative density (no units)
DOM	direction of motion
DOR	direction of rotation
DP	diametrical pitch
DVN	driven
DVR	driver
<i>E</i>	Young's Modulus (Modulus of Elasticity) (N/m^2) or equilibrant force (N)
<i>e</i>	tensile or compressive strain, or transmission efficiency
<i>F</i>	force (N)
<i>f</i>	stress (N/m^2) or final drive ratio
FR	force ratio (or mechanical advantage)
<i>g</i>	acceleration due to gravity (usually taken as 9.81 m/s^2)
GR	gear ratio
<i>h</i>	height (m) or hub reduction ratio

xiv *Nomenclature*

hp	horse power
ihp	indicated horse power
imep	indicated mean effective pressure (p_m) (N/m^2 , Pa)
L	length (m)
l	latent heat (J/kg)
L of P	limit of proportionality
LCV	lower calorific value
m	mass (kg)
mc	master cylinder
ME	mechanical efficiency (%)
MP	module pitch
MR	movement ratio
N	revolutions per minute (rev/min)
n	number (e.g. pistons) or reduction ratio
NTP (or STP)	normal (or standard) temperature and pressure
P	power (W)
p	pressure (Pa, N/m^2)
PC	pitch circle
PCD	pitch circle diameter (m)
R	reaction (or resultant force) (N) or radius (m)
r	compression ratio (CR)
S	distance or displacement (m) or piston speed (m/s)
SF	shearing force (N)
SFC	specific fuel consumption ($\text{kg}/(\text{kW h})$ or $1/(\text{kW h})$)
STP	see NTP
TE	tractive effort
T	temperature ($^{\circ}\text{C}$, K) or torque (N m) or number of gear teeth
t	time (s, h)
TDC	top dead centre
u	initial velocity (m/s)
V	volume (m^3) or velocity (m/s)
v	velocity or final velocity (m/s)
wc	wheel cylinder (hydraulic)
W (or w)	weight or load (kg)
x	extension (m)

Greek letters

α	coefficient of linear expansion (per $^{\circ}\text{C}$)
η	efficiency (%)
μ	coefficient of friction

ρ	density
ϕ, θ	angles (rad, °)
ω	angular velocity (rad/s)

Subscripts

B	big end
b	bearing or braking
c	connecting rod or clearance or crown
D	drag
d	drum
e	expanded
F	front
f	fusion or friction
I	inlet
i	indicated or inner
L	leading
m	mean or mechanical
N	normal or nearside
O	outlet or offside
o	outer
p	piston
R	road or rear
r	radial
s	swept or servo or shoe
T	trailing
t	total or tangential
w	cylinder wall