

MOTOR MACHINING THEORY

GENERAL REMARKS

- (i) In teaching this subject in all the grades, neat freehand sketches in fairly good proportion with a pencil, rule and compass should form a supplementary part of the work. No formal or complicated drawings, or pictorial representations or isometric sketches and no definite angles and sizes should be required in sketches. In the main, simple outline sketches should be used to illustrate constructional features and technical details to supplement the descriptive work. Descriptions and information should be based specifically on the technical aspects, characteristics, properties, uses, etc. of the tools, machines, or processes dealt with.
- (ii) The syllabuses in the grades NI, N2 and N3 for this subject are given below. The teaching in each grade must cover the whole syllabus.
- (iii) The subject matter in these syllabuses must be presented according to the Systéme Internationale (SI). In this respect reference must be made to: "METRIC STANDARDS FOR ENGINEERING, B.S. HANDBOOK NO.18, 1966", and later editions.
- (iv) Reference should only be made to work of previous grades where this is necessary for a better understanding of the subject contents which are covered by the syllabus.
- (v) Safety precautions must not be generalised but must always be borne in mind and mentioned in connection with specific instances where applicable.

MOTOR MACHINING THEORY NI

(One 3-hour paper)

1. General safety and courtesy to others.
2. Use and care of hand tools; torque wrenches.
3. Nomenclature. Names and functions of engine parts.
4. Bolts and nuts. Different types of bolts, nuts and screw threads normally used by motor car manufacturers; screw threads; thread gauges and other measuring equipment normally used for the measuring of bolts, nuts and screw threads; use and care of measuring equipment; removal of broken studs.
5. Cleanliness. Necessity for cleanliness; shop cleanliness; cleanliness while assembling.
6. Engines. Principles of operation; four-stroke petrol and CI engines; two-stroke petrol engines; two-stroke valveless CI engines; two-stroke parallel exhaust valve CI engines; rotor engines.
7. Lubrication. Function; systems (force and full force); oil pumps, (plunger, gear, rotor and vane); pressure reducing valves; filters (full flow and bypass); causes of low oil pressure and methods of remedying; pressure indicators; warning systems.
8. Crankcases. Ventilation systems; positive crankcase ventilation; oil seals; types; materials; oilslingers; filters (various types normally used); sealing of crankcase assemblies and oil sumps.
9. Bearings. Causes of failure; materials; clearances; draw, function of draw; measuring of draw; small end bushes; camshaft bearings.

10. Pistons. Design; materials; cam; clearances; gudgeon pins; off-set of gudgeon pins; effect of design on clearances; measuring methods; measuring instruments normally used; working tolerances.
11. Sleeves. Wet and dry sleeves; interference fit of sleeves; materials normally used; sealing.
12. Rings. Function; gap; materials; types of oil control rings; expanders and expander springs; chrome rings.
13. Temperature control: Purpose of temperature control; dangers of overheating and overcooling. Air cooling; open cylinders; closed cylinders; function and operation of shrouds, blowers, thermostats and oil coolers. Water cooling: Function of the radiator; types of radiators. Cooling systems: Impeller-assisted thermosyphon, pressurised, positive pump system, waterpumps, glands and seals; water distribution tubes; thermostats; thermostatic control; shutters; pressure radiator caps.
14. Camshafts and followers. Function; rotation; hydraulic lifters; thrust; types of camshafts normally used; importance of correct cam forms.
15. Timing. Timing chains; tensioners; timing gears; rockers; overlap; oil plugs.

MOTOR MACHINING THEORY N2

(One 3-hour paper)

1. Valves and guides. Function; materials; clearances; angles; seats; seat inserts; stem seals; cotters; rotators; valve protrusion; valve spring tension.
2. Valves: Function and operation of the different types of valves; valve lay-out; side valves; half-overhead half-side valves; overhead cam valves; in-line valves; in-line angled valves.
3. Valve timing. Valve timing diagrams; necessity for lead, lag and overlap; tappet clearance; timing gears, chains and tensioners.
4. Wear limits for engine parts. Methods of checking engines and engine parts before overhauling; checking and measuring equipment normally used; dismantling procedure; assembly procedure.
5. Flywheel, ring gears and vibration dampers. Types and functions of flywheel ring gears and vibration dampers; removal and fitting of vibration dampers and ring gears and flywheels. Testing for run-out.
6. Materials. Types and properties of metals normally used for engine parts; identification; expansion; cast iron; steel; alloys; bronze; brass; copper; white metal; aluminium; synthetic materials. (Give the reasons for use of each).
7. Machining. Methods of machining; cutting speeds; tools; tool sharpening; drills and drill sharpening; drill angles.
8. Grinding machines. Types of grinding machines normally used for surface grinding, cylindrical grinding and internal grinding; types of work suitable for machining by means of the grinding process; the use of fixtures and clamping devices; care of machines.

9. Grinding wheels. Types of grinding wheels normally used; wheel shapes; wheel construction including grit, grain, bond and shape; wheel speeds; wheel balancing, testing and mounting; wheel dressing and truing; cutting rates; lapping and honing; cooling and cooling media.
10. Crankshaft and camshaft grinding. Grinding wheel balancing; truing; radiusing and use of radius gauge; reasons for radii on shafts; chucks and setting-up; balance weights; taper and rectification; ovality; chatter and rectification; camshaft grinding.
11. Reboring and resleeving. Boring bars and tools; use of tool-setting micrometers; setting-up; clearances; feeds and speeds; finish; tools and tool sharpening; checking with feelers; micrometers and dial-test gauges; care of diamond discs and grinding wheels.

MOTOR MACHINING THEORY N3

(One 3-hour paper)

1. Bearings. Fitting of bearings; draw; importance of draw; reasons for draw, measuring of draw.
2. Connecting-rods. Resizing of connecting rods; setting-up; measuring; grinding of bearing caps; internal grinding and machining.
3. Small ends. Types normally used, preparing of rods for fitting of small end bushes; reamers; hones; line-boring machines; tool sharpening; feeds and speeds.
4. Big-end machines. (White metal). Remetalling, tinning and sounding; tools normally used; marking out and setting-up; radii and chamfers; oil grooves.
5. Conrod alignment. Importance of alignment; fixtures and methods; measuring and checking equipment.
6. Line-boring. Preparation of blocks and caps; machines normally used; setting-up; tools and cutting speeds for boring bearings and housings.
7. Cylinder heads. Resurfacing; setting-up; compression ratio; valve protrusion.
8. Lathes. Simple general turning; taper turning; types of tool holders and tools; tool sharpening; boring bars.
9. Valves. Valveseats; seat inserts; refacing machines; angles and grinding-wheel dressing; seat-refacing machines; seat widths and depths; materials; procedure for recessing; interference fits; subsequent finishing and valve protrusion.
10. Guides. Removal; fitting; reaming; seat concentricity; valve stem clearance; fitting to aluminium heads.
11. Brake drums and discs. Machining of brake drums and brake discs; brake drum machines; limit of material removal on brake drums and discs; setting-up and checking runout and ovality.

MOTORMASJINEERTEORIE

ALGEMENE OPMERKINGS

- (i) By die onderrig in al die grade van hierdie vak behoort netjiese sketse in redelike goeie verhouding uit die vrye hand met potlood, liniaal en passer 'n aanvullende deel van die werk uit te maak. Geen formele of ingewikkelde tekeninge, of prentagtige voorstellings, of isometriese sketse en geen definitiewe hoeke en mate moet by sketswerk vereis word nie. Daar moet hoofsaaklik van lynsketse gebruik gemaak word om konstruksiekenmerke en tegniese besonderhede te illustreer en om die beskrywings aan te vul. Beskrywings en inligting moet spesifiek op die tegniese aspekte, kenmerke, eienskappe, gebruike, ens. van 'n gereedskapstuk, masjien of proses wat behandel word, toegespits wees.
- (ii) Die sillabusse in die grade N1, N2 en N3 vir hierdie vak word hieronder gegee. Onderrig in elke graad moet die hele sillabus dek.
- (iii) Die leerstof in hierdie sillabusse moet volgens die Systéme Internationale (SI) aangebied word. In die verband word verwys na: "METRIC STANDARDS FOR ENGINEERING, B.S. HANDBOOK NO.18, 1966", en latere uitgawes.
- (iv) Verwysing na werk van die vorige grade moet slegs geskied waar dit nodig is vir 'n beter begrip van die vakinhoud van wat deur die sillabus gedek is.
- (v) Veiligheidsmaatreëls moet nie veralgemeen word nie maar moet deurgaans in gedagte gehou en genoem word in verband met spesifieke omstandighede waar dit van toepassing is.

MOTORMASJINEERTEORIE N1

(Een 3-uurvraestel)

1. Algemene veiligheid en hoflikheid teen ander.
2. Gebruik en versorging van handgereedskap; wringsleutels.
3. Nomenklatuur. Name en funksies van enjindele.
4. Boute en moere. Verskillende tipes van bout, moere en skroefdrade wat normaalweg deur motorkarvervaardigers gebruik word; skroefdraadmate en ander meetuitrusting wat normaalweg gebruik word vir die meet van bout, moere en skroefdrade; gebruik en versorging van meetuitrusting; verwydering van gebreekte tapbout.
5. Sindelikheid. Noodsaaklikheid van sindelikheid; werkplaassindelikheid; sindelikheid tydens samestelling.
6. Enjins. Beginself van werking; vierslagpetrol- en vierslagkompressie-ontstekingsenjins; tweeslagpetrolenjins; tweeslagkompressie-ontstekingsenjins sonder kleppe; tweeslagkompressie-ontstekingsenjins met paralleluitlaatklep; rotorenjins.
7. Smering. Funksie; stelsels (druk- en voldruksmering); oliepompe (plunjer, rat, rotor en wiek); drukverlagingskleppe; filters (volstroomfilter en omloopfilters); oorsake van lae oliedruk en metodes van regstelling; drukmeters; waarskuwing-stelsels.
8. Krukkasse. Ventilasiestelsels; positiewe krukkasventilasie; olieseëls; tipes; materiale; oliewerpers; filters (verskillende tipes wat normaalweg gebruik word); afdigting van krukkassamestellings en oliebakke.
9. Laers. Redes vir swigting; materiale; vryruimtes; trek, funksie van trek; meting van trek; suierpenbusse; nokaslaers.

10. Suiers. Ontwerp; materiale; nok; vryruimtes; suierpenne; afwyking van suierpenne; invloed van ontwerp op vryruimtes; meetmetodes; meetinstrumente wat gewoonlik gebruik word; werktoleransies.
11. Voerings. Nat en droë voerings; stuitpassings van voering; materiale wat normaalweg gebruik word; afdigting.
12. Ringe. Funksie; spleetopening; materiale; tipes van oliebeheerringe; uitdyers en uitdyvere; chroomringe.
13. Temperatuurbeheer: Doel van temperatuurbeheer; gevare van oorverhitting en oorverkoeling. Lugverkoeling; oop silinders; toe-silinders; funksie en werking van skerms, blasers, termostate en oliekoelers. Waterkoelers: Funksie van die verkoeler; tipes verkoelers. Koelstelsels: Stuwergesteunde termohewel, onder druk, positiewe pompstelsel, waterpompe, drukstukke en seëls, waterverspreidingsbuis, termostate; termostatische beheer; luike; drukverkoelers.
14. Nokasse en nokvolgers. Funksie; rotasie; hidroulise ligters; stuwing; tipes van nokasse wat normaalweg gebruik word; belangrikheid van korrekte nokvorms.
15. Tydreëling. Tydreëlkettings; verspanners; reëlratte; tuimelaars; oorslag; olieproppe.

MOTORMASJINEERTEORIE N2

(Een 3-uurvraestel)

1. Kleppe en klepleiers. Funksie; materiale; vryruimtes; hoeke; beddings; klepinlaatbeddings; klepsteelseëls, spye; draaiers; klepuitsteking; klepveerspanning.
2. Kleppe: Funksie en werking van die verskillende kleptipes; kleprangskikking; sykleppe; halfbobrug-halfsykleppe; bonokaskleppe; gelidkleppe; gelid-hoekige kleppe.
3. Klepreëling. Klepreëlingsdiagramme; noodsaaklikheid van voorloop, naloop en oorslag; klepspelings; reëlratte; kettings en verspanners.
4. Slytasielimiete vir enjindele. Metodes van kontrolering van enjins en enjindele voor versiening; kontrole- en meettoerusting wat gewoonlik gebruik word; demonteringsprosedure; samestellingsprosedure.
5. Vliegwiele, kransratte, en trillingsdempers. Tipes en funksies van vliegwiele, kransratte en trillingsdempers; verwydering en passing van trillingsdempers, kransratte en vliegwiele; toets vir waggeling.
6. Materiale. Soorte en eienskappe van metale wat normaalweg gebruik word vir enjindele; uitkenning; uitsetting; gietyster; staal; legerings; brons; geelkoper; koper; witmetaal; aluminium; sintetiese materiale (verstrek die redes vir gebruik in elke geval).
7. Masjinerie. Metodes van masjinerie; snytempo's; gereedskap; skerpmmaak van gereedskap; bore en skerpmmaak van bore; boorpunthoeke.
8. Slypmasjiene. Tipes van slypmasjiene wat gewoonlik gebruik word vir vlakslypwerk, silindriese slypwerk en binneslypwerk; tipes van werk wat geskik is vir masjinale slypbewerking; die gebruik van hegstukke en klemtoestelle; versorging van masjiene.

9. Slypwiele. Tipes van slypwiele wat gewoonlik gebruik word; slypwiel=fatsoene; slypwielkonstruksie met inbegrip van grut, grein, bindmiddel en fatsoen; slypwielspoed; slypwielbalansering, toetsing en montering; slypwielbereiding en -opsuiwering; snytempo's; fynslyp- en aansitwerk; verkoeling en verkoelingsmedia.
10. Krukas- en nokasslypwerk. Slypwielbalansering; opsuiwering; radius-aansitting en gebruik van straalmaat; rede vir radiusse aan asse; klemkoppe en opstelling; balanseergewigte; tapsheid en regstelling; ovaliteit; klapper en regstelling; nokasslypwerk.
11. Herboor- en herbehulsing. Boorstawe en -gereedskap; gebruik van gereedskapopstelmikrometers; opstelling; vryruimtes; snittoevoere en slypsnelhede; afwerking; gereedskap en skerpmaak daarvan; kontrole met behulp van voelermate; mikrometers en wyserplaatmeters; versorging van diamantskywe en slypwiele.

MOTORMASJINEERTEORIE N3

(Een 3-uurvraestel)

1. Laers. Pasmaking van laers; trek; belangrikheid van trek; redes vir trek; meting van trek.
2. Suierstange. Terugvorming van suierstange; opstelling; metings; slyp van laerkoppe; binneslypwerk en masjinerie.
3. Kleinkoppe. Verskillende tipes wat normaalweg gebruik word; voorbereiding van suierstange vir pasmaking van kleinkopbusse; ruimers; wetstene; lynboormasjiene; snygereedskapslypwerk; snittoevoere en snelhede.
4. Grootkopmasjiene (Witmetaal). Hermetallisering; vertinning en verstewiging; gereedskap wat gewoonlik gebruik word; uitmerk en opstelling; radiusse en afkantings; oliegroewe.
5. Suierstangrigting. Belangrikheid van suierstangrigting; hegstukke en metodes; meet- en kontrole-uitrusting.
6. Lynboorwerk. Voorbereiding van blokke en kappe; masjiene wat normaalweg gebruik word; opstelling; gereedskap en snytoevoere vir uitboor van laers en laeromhulsels.
7. Sillinderkopstukke. Hervlakkings; opstelling; kompressieverhouding; klepuitstekings.
8. Draaibanke. Eenvoudige algemene draaiwerk; tapsdraaiwerk; tipes van gereedskaphouers en gereedskap; gereedskapslypwerk; boorstawe.
9. Kleppe. Klepbeddings; klepinlaatbeddings; hervlakkingsmasjiene; hoeke en slypwielbereiding; beddinghervlakkings-masjiene; bedding-wydtes en -dieptes; materiale; uithollingsprosedure; stuitpassings; opvolgingsafwerking en klepuitstekings.
10. Klepleiers. Verwydering; pasmaking; ruiming; beddingkonsentrisiteit; klepsteelvryruimte; pasmaking van aluminiumkopstukke.
11. Remtrommels en -skywe. Masjinerie van remtrommels en -skywe; remtrommelmasjiene; limiete van materiaalverwydering aan remtrommels en -skywe; opstelling en kontrole van waggeling en ovaliteit.