SEAGOING ENGINEER OFFICER CLASS 2

CERTIFICATE OF COMPETENCY

ELECTROTECHNOLOGY

Time allowed: 3 hours

Instructions:-

This paper consists of NINE questions where

Candidates are required to attempt ANY SIX questions.

All questions carry equal marks.

Pass marks: 50 %

CANDIDATES ARE NOT ALLOWED TO WRITE ON OR DEFACE THIS PAPER

This paper consists of this page and FOUR other printed pages.

Notes to Candidates:-

i)   Write down your name in the top right-hand corner on the first page of the answer sheets.

ii)   Write down the question number in the top left-hand corner on each page.

iii) Answer each question on a new page.

iv)   No need to copy the questions' details onto the answer sheets.

v)   Switch off all your mobile phones and communication devices when in the examination room.

vi) Return all the question paper(s), the used and unused answer sheets before leaving the examination room.

vii) Do not disturb other candidate(s) in the examination room.

viii) Do not attempt to take any photos or recordings of any question papers and/or answer sheets.

ix)   The progress of the examination is being recorded by close-circuit television (CCTV) and voice recorders in the examination room.

If the above rules from item v) to viii) are infringed, candidates will be regarded as having failed the examination as a whole and will not be accepted for re-examination for such period as may be decided by the Director.

考生注意事項：-

i)   在答題紙首頁右上角寫上姓名。

ii)   在每頁答題紙的左上角標明回答的問題題號。

iii) 每一條問題另開新頁作答。

iv)   不需要抄寫問題到答題紙上。

v)   進入試場後，把手機及所有通信設備關閉。

vi) 離開試場前，交回所有試卷、所有用過和未用過的答題紙及草稿紙。

vii) 試場內不可干擾其他考生。

viii) 切勿嘗試拍攝或錄取任何試卷或答案。

ix)   考試期間試場內會有閉路電視(CCTV)和錄音系統進行記錄。

如果違反上述 v) 至 viii) 規則，即當作所有考試不及格，以及在處長決定的期間內不得重考。

1. A resistor of 25 Ω and a coil having an inductance of 8 mH and resistance of 10 Ω are connected in parallel to a 12 V, 400 Hz supply.   Calculate the current in each branch.

    Sketch a phasor diagram and determine the current taken from the supply.

2. Twelve cells, each of e.m.f. 1.5 V and internal resistance 0.225 Ω, are arranged four in series per row or bank, with three banks in parallel.   The battery so formed is connected to a load consisting of a series-parallel resistor arrangement, made up of a 2 Ω resistor connected in parallel with a 3 Ω resistor, these in turn being connected in series with a 2.5 Ω resistor.   Find the battery terminal voltage, the power ratings of the resistors and the energy converted into heat in the complete circuit if the arrangement is switched on for 1 hour.

3. Explain with aid of a circuit diagram, how to determine the following operating characteristics of a p-n-p transistor with common base configuration.

    (a)   the input characteristic;

    (b)   the output characteristic; and

    (c)   the transfer characteristic.

4. A circuit having a resistance (R) of 12 Ω, an inductance (L) of 0.15 H and a capacitance (C) of 100 μF in series, is connected across a 100 V, 50 Hz. Calculate :
    (a)   the impedance of the circuit;
    (b)   the current in the circuit;
    (c)   the voltage across the R, L and C;
    (d)   the power.; and
    (e)   the phase difference between the current and supply voltage.

    Sketch a phasor diagram of the current and the voltages.

5. A 10 kW compound d.c. motor is supplied from a 240 V supply and at full load runs at 500 rev/min. The motor has the following resistances:

Shunt field   =   200 Ω;

Series field   =   0.05 Ω;

Armature   =   0.05 Ω.

Calculate:

(a)   the full load current taken from the supply; and

(b)   the motor speed when the current taken from the supply is reduced to half of the full load current.

[Remark: Neglect the mechanical loss]

6. (a)   Explain what is meant by armature reaction.

(b)   A d.c. short-shunt compound generator supplies a current of 100 A at 220 V. The resistance of the shunt field is 50 ohm, of the series winding 0.025 ohm and of the armature 0.05 ohm. Iron and friction losses amount to 1 kW.

Calculate   i.)   the e.m.f. generated;

ii.)   the copper losses;

iii.)   the power of the generator; and

iv.)   the efficiency.

7. (a)   Sketch and describe a miniature circuit breaker, and give an example of where it would be used.

(b)   Sketch and describe a high breaking fuse, and state the advantages of such fuse.

8. Coil A, has a resistance of 24 ohms and inductance of 0.12 H, and Coil B, has a resistance of 28 ohms and inductance of 0.14 H.

If Coils A and B are connected in series across :

(a)   a 115 V d.c. supply, and

(b)   a 240 V a.c , 60 Hz supply.

Determine the circuit current and power in each case.

9   (a)   Two long parallel busbars each carry 2,000 A and are spaced 0.8 m apart between centres.   Calculate the force / metre acting on the conductors.

(b)   The armature of a four-pole generator rotates at 600 rev/min. The area of each pole-face is 0.09 m^2 and the flux density in the air-gap is 0.92 tesla. Find the average e.m.f. induced in each conductor. If the armature winding is made up of 210 single-turn coils connected so as to provide four parallel paths between the brushes, find the generator terminal voltage.

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