[This question paper contains 7 printed pages]

Roll No.	

ASME-24BC-EENG-II

ELECTRICAL ENGINEERING (PAPER-II)

Time Allowed: 3 Hours [Maximum Marks: 100

QUESTION PAPER SPECIFIC INSTRUCTIONS

Please read the following instructions carefully before attempting questions.

1. There are EIGHT questions printed in English.
2. Candidate has to attempt FIVE questions in all.
3. Question No.1 is compulsory. Out of the remaining SEVEN questions, FOUR are to be attempted.
4. All questions carry equal marks. The number of marks carried by a question / part are indicated against it.
5. Write answers in legible handwriting.
6. Wherever any assumptions are made for answering a question, they must be clearly indicated.
7. Diagrams / Figures, wherever required, shall be drawn neatly. Unless otherwise mentioned, symbols and notations carry their usual standard meanings.
8. Attempts of questions shall be counted in sequential order. Unless struck off, attempt of a question shall be counted even if attempted partly. Any page or portion of the page left blank in answer book must be clearly struck off.
9. Re-evaluation / Re-checking of answer book of the candidate is not allowed.
10. Graph and Semi-log paper may be required to answer some questions.

1. (a) A Given a plant with state space representation given by 05

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 1 & 2 \\ -6 & -5 & -2.66 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} u \qquad y = [1 \quad 0 \quad 1]x$$

Obtain the equivalent transfer function representation of the system and determine using Routh Hurwitz criterion whether system is stable or not?

(b) Give the sequence of operations in Direct Memory Access (DMA)? Discuss various DMA modes and explain burst mode type of DMA controller in details using flowchart. Further explain why each channel in 8257 DMA controller is registered to 16K byte data transfer. 05

(c) Three resistances $R_1 = 50\Omega \pm 10\%$, $R_2 = 100\Omega \pm 5\%$ and $R_3 = 100\Omega \pm 5\%$ are connected in such a fashion that R_1 is connected in series with the parallel combination of R_2 and R_3. Determine the limiting error in overall resistance for this combination. Calculate the errors in the power calculation using the formula $P = VI$, when the measured values of V and I are $V = 100 \pm 10\%$ and $I = 1 \pm 5\%$. 05

(d) A 330kV, 50Hz transmission line delivers 400MVA of power at 0.8 lagging power factor at 300kV. The ABCD parameter matrix of the transmission line are given as 05

$$\begin{bmatrix} .982 + j0.0012 & 4 + j59.01 \\ j0.00062 & .982 + j0.0012 \end{bmatrix}$$

Determine the sending end quantities, transmission efficiency and the voltage regulation of the transmission line.

2 (a) Differentiate between dry and wet etching techniques. Discuss the effects of four main etching parameters in wet etching process. Elaborate any one wet etching technique in details. 07

(b) A piezo-electric transducer has a charge sensitivity of $50pC/N$, a capacitance of 1000pF, and resistance of $2 \times 10^6 M$. The connecting cable has a capacitance 07

of 300pF, while the measuring system has a capacitance of 500pF in parallel with 1MΩ. A force $F = 1N$ is applied for time $0 < t < .1mS$ and removed after $t = 0.1mS$. Find the voltage across the transducer just before and after $t = 0.1mS$. Further, compute the transducer voltage after $5mS$.

(c) A source emits seven messages with probabilities 1/2,1/4,1/8,1/16, 1/32, 1/64, 1/64 respectively. Find the entropy of the source. Obtain the compact binary code for messages and find the average length of the code word. Also, find the efficiency and redundancy of the code. 06

3. (a) Given a plant with the following state space representation 07

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -1 & -1 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u \qquad y = [1 \quad 1]x$$

Check whether the given plant is controllable and observable or not? Design an integral controller to achieve peak overshoot of 15%, settling time of 0.6 secs and zero steady state error for step input.

(b) Explain BPSK briefly using schematics of BPSK transmitter, and giving illustration discuss the operation of a balanced ring modulator. For a given BPSK modulator with carrier frequency of 82MHz and an input bit rate of 10Mbps, determine 07

(i) Maximum upper and Minimum lower side frequencies

(ii) Minimum Nyquist Bandwidth and Baud

Also sketch the output spectrum.

(c) A 50Hz generator is delivering 0.6 pu of power to an infinite bus through a transmission line. The generator and transmission line have 0.3pu and 0.15pu reactance, respectively. The inertia constant of generator is 3MW-sec/MVA. Determine the excitation voltage of the generator and frequency of natural oscillations. Also find the excitation voltage of the generator and frequency of natural oscillations when generator is loaded to 75% of its maximum power transfer capability. 06

4. (a) Sketch the equivalent circuit of a photo-voltaic (PV) cell and derive expression for maximum power output of PV cell. Given a PV cell operating at $27°C$ with short-circuit current density of $160\ A/m^2$, reverse saturation current density of $7.9 \times 10^{-9}\ A/m^2$. Find the effective surface area need to produce an output of $60W$, if the radiation intensity is $920\ W/m^2$. Also estimate the conversion efficiency. 07

(b) Explain the working principle, construction, and applications of a Thermistor. Further, given a thermistor which has a resistance of 1967.6Ω at normal temperature and 794Ω at 50^oC. Calculate the thermistor constant. Calculate the range of thermistor resistance when the temperature changes from 60^oC to 120^oC. 07

(c) Given a unity feedback control system with forward path gain $G(s) = \frac{K(s-2)}{(s+1)(s^2+5s+25)}$. Find the value of K such that the overall system admits a 10% steady state error to constant inputs. Further, find the range of gain K over which the system remains stable under unity feedback. Also discuss the high gain behavior of the closed loop system. 06

5. (a) A unity feedback system has an open loop transfer function $G(s) = \frac{K}{s(s+6)}$ and is operating with peak overshoot of 9.48%. Sketch the Bode plot for the system, and design a suitable compensator such that the closed-loop system admits $K_v = 100$, while the phase margin and gain margin remain the same as that of the uncompensated system. 07

(b) A 11kV, 50Hz generator is to be protected using a balanced circulating current system that uses earthing resistance to control fault currents. The neutral of the generator is grounded through an 8 Ω resistance. The protective relay operates when out of balance current of 2A is sensed in the pilot wires, when connected to the secondary winding of 1000/4 current transformers. Calculate 07

(i) the percentage of winding that remains protected

(ii) the minimum amount of additional earthing resistance required to protect 85% of winding.

(c) Derive the expression for quantization noise in a PCM system. Given a PCM system which uses uniform quantizer followed by an encoder. The output signal to quantizing noise ratio of the system is to be maintained at a minimum of 40dB. The system is operating at 50Mbps. Determine 06

(i) the number of required levels

(ii) the maximum message bandwidth for which the system operates satisfactorily

(iii) the output signal to noise ratio if a modulating input of 1Mhz is applied to the input.

6. (a) Explain the interfacing of two $16K \times 8$ RAM with the 16-bit data bus in 8086 based system, using a block diagram. Further, design the address decoder for the address range from 00000H-07FFFFH for both of the RAMs. 07

(b) A 50MVA, 30kV generator with solidly grounded neutral has a sub-transient reactance of 0.25pu. The negative and zero sequence reactance are 0.3pu and 0.1pu respectively. A double line to ground occurs at the terminals of the generator, calculate the fault current and line to line voltages. 07

(c) Explain the Meissner Effect and mixed-state Meissner effect in superconductors. Differentiate between Type-1 and Type-2 superconductors and give two example materials for each type. Further, sketch and explain the graph showing the relation of the energy gap in superconductors as a function of temperature. 06

7. (a) Write 8086 assembly language program to insert a block of 10 bytes of data in 100 bytes of data block stored in the memory from the 10^{th} position and onwards i.e. 11^{th} byte of existing memory data will be replaced by the first byte of 10 bytes of data to be inserted and so on. 07

(b) To a 11kV, three phase, 50Hz power supply, three loads are connected in parallel 07

- Inductive Load 60kW and 660kVAR
- Capacitive Load 220kW at 0.8 power factor
- Resistive Load of 50Kw

(i) Find the total complex power, power factor and the supply current

(ii) Further, a Y-connected capacitor bank is connected across this combination to improve the power factor, find the required capacitance per phase of the bank to improve the power factor to 0.8 lagging. Also find the new line current.

(c) Sketch the schematics and phasor diagram of a Schering bridge and derive the relations for balance condition and relation for dissipation factor. Also, discuss the application of the Schering bridge. 06

8. (a) A propeller type HAWT has the following parameters: $\alpha = 0.13$, air density=$1.226\ kg/m^3$, hub height from the ground = 80 m, Rotor diameter = 60 m. If average free wind speed at a standard height of 10 m is 8 m/s, and wind velocity at the turbine reduces by 30%. If the generator efficiency is 85%, find: 07

(i) Total Power available in the wind

(ii) Power extracted by the turbine

(iii) Axial force on the turbine

(iv) Electrical power generated

(iv) Axial force on the turbine under the condition when,

(a) maximum power is extracted and

(b) no power is extracted and the blade stalls completely.

(b) Sketch the schematic view and cross section of an optical fibre. Differentiate between single mode and multi-mode optical fibre and derive expression for numerical aperture of an optical fibre. Further, explain using diagram the Vapour Axial Deposition scheme for optical fibre fabrication. 07

(c) The undamped dynamics of a satellite are given as $G(s) = \frac{1}{s^2}$. Sketch the root locus diagram for the given system and design a lead compensator such that the closed loop system achieves a peak overshoot of 16.3% and a settling time of 4 secs for 2% tolerance band. 06

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