D. J. SANGHVI COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRONICS ENGINEERING
ELECTRONIC DEVICES SEM III
MID TERM 1 SYLLABUS

N.B. : **[Total Marks: 20]**

1) In the paper, there will be four questions of 5 marks each covering the mid term 1 syllabus.
2) Standard constants values w.r.t to Si like V_T, n_i, q, ϵ_s will not be given in exam.
3) Carry calculators in the exam room.

✠ PN JUNCTION

1. PN structure and assumptions.
2. Energy band diagram (EBD) of pn junction under equilibrium or zero-bias.
3. Derivation of built-in potential (V_{bi}), Electric field (E) and Space-charge or depletion width (W).
4. Analysis of pn junction in forward and reverse bias.
5. EBD of pn junction in forward and reverse bias.
6. Numericals on built-in potential (V_{bi}), Electric field (E) and Space-charge or depletion width (W) for a pn junction in zero-bias, forward bias and reverse bias.
7. Ideal diode equation derivation for a pn junction (*NOT in subject syllabus*), only minority carrier distribution for a pn junction concept needs to be studied.
8. Numericals on Ideal-diode equation (reverse saturation current and diode current in forward and reverse bias)
9. Zener and Avalanche breakdown mechanisms (explanation w.r.t to EBD's)
10. PN junction capacitance: a) Diffusion capacitance and b) Depletion capacitance.
11. Small- signal model of pn junction.
12. Numerical on Depletion capacitance.
13. Ideal pn junction diode assumptions.
14. Reverse-bias generation current and forward-bias recombination current.
15. Practical I-V characteristics of pn junction diode and its interpretation.
16. Varactor diode characteristics and working.

✠ ZENER DIODE

1. Zener diode I-V characteristics.
2. Zener as voltage regulator.
3. Backward diode characteristics and working.

✠ BIPOLAR JUNCTION TRANSISTOR

1. BJT structure and related configurations (CE, CC and CB).
2. Working of npn and pnp transistor with input and output I-V characteristics in Common emitter configuration.
3. EBD of npn and pnp BJT under zero-bias or equilibrium and forward-active mode.
4. α and β relation in npn transistor.
5. Minority carrier distribution (MCD) in forward-active mode and related terms and diagram of MCD.
6. Derivation of Minority carrier distribution (MCD) in forward-active mode for npn BJT. (*NOT in Mid term 1 syllabus*)
7. MCD for npn transistor operating in cut-off, saturation and inverse-active mode. (*NOT in Mid term 1 syllabus*)
8. Low frequency common base current gain, various current components in an npn BJT.
9. Meaning of Emitter injection efficiency, base transport factor and recombination factor w.r.t BJT and related formulas.
10. Derivation of Emitter injection efficiency, base transport factor and recombination factor w.r.t npn BJT. (*NOT in Mid term 1 syllabus*)
11. Eber's Moll model for an npn BJT and validity that is works for all operating modes(forward-active, saturation, inverse-active and cut-oof modes)
12. Hybrid-Pi model for transistor.
13. Non-ideal effects in BJT: a) Base width modulation b) High Level injection c) Non-uniform base doping d) Breakdown mechanisms in BJT and e) Emitter band-gap narrowing.
14. Frequency limitation effects in BJT: Various time-delay factors in BJT, transistor cut-off frequency and beta cut-off frequency.
15. Numerical on Emitter to collector transit time, transistor cut-off frequency and beta cut-off frequency.
16. Gummel-Pool Model (*NOT in Mid term 1 syllabus*)

✠ JUNCTION FIELD EFFECT TRANSISTOR

1. JFET types and its structure. How JFET and BJT are different.
2. Working of n-channel or p-channel JFET w.r.t output and transfer characteristics.
3. Analysis of output and transfer characteristics: Transconductance g_m, Shockley's equation relating I_D, I_{DSS} and V_P.
4. JFET related terms: a) Internal pinch-off voltage b) Pinch-off voltage and c) Drain to source saturation voltage.

5. Device characteristics of n-channel JFET i.e derivation of I_D. (*NOT in Mid term 1 syllabus*)

6. Numerical on Shockley's equation, transconductance g_m , internal pinch-off voltage V_{p0}, pinch-off voltage V_P and $(V_{DS})_{sat}$.

7. Small signal equivalent circuit for JFET.

8. Frequency limitations factors and cut-off frequency for JFET.(*NOT in Mid term 1 syllabus*)

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