BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
CE -G534 PAVEMENT MATERIAL CHARACTERIZATION
SEMESTER I, 2022-23
MID - SEMESTER EXAMINATION (CLOSE BOOK)

Date: 03-11-2022 **Time: 90 minutes**
Max. Marks: 50

INSTRUCTIONS:

- *Support your answers with **neatly labelled** sketches wherever necessary.*

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Q1. Calculate percentage passing using Fuller's gradation and FHWA gradation if the maximum size of aggregate is 26.5 mm and other sizes to be considered are 19 mm, 12.5 mm, 9 mm, 6.36 mm, 4.75 mm, 2.36 mm, 300 micron and 75 micron. Provide the end result in a tabular form. Detailed steps are required. ***[6 Marks]***

Q2. The graphical results of a Dynamic Shear Rheometer test conducted on PG 64-28 binder are shown in Figure 1. Determine the rutting parameter of the binder. The angle is provided in degrees. ***[5 Marks]***

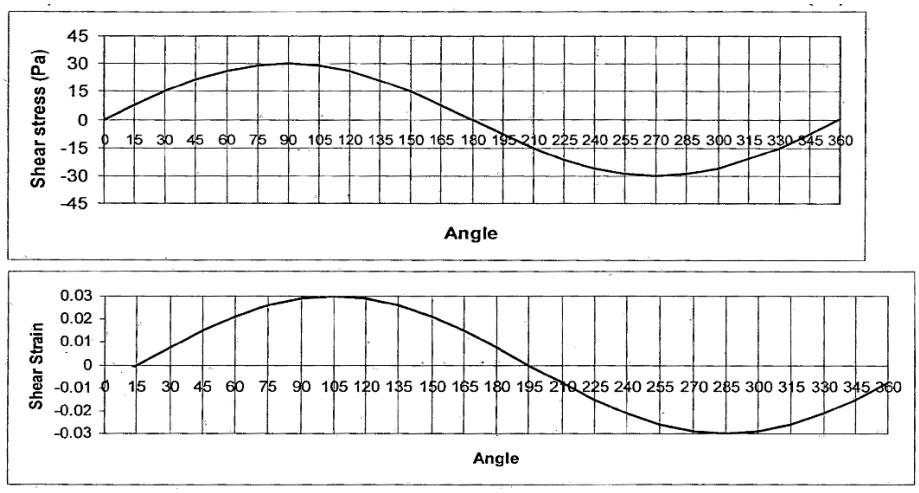

Figure 1: Dynamic Shear Rheometer test results

Q3. (i) Name the test that helps in assessing the suitability of a bitumen in cold – weather conditions. ***[1 Mark]***

(ii) Define zero shear viscosity. ***[1 Mark]***

(iii) Provide technical comments on VG 20, S35, PMB(E)40 and CRMB 55. Also state the significance of the numeric values. ***[2 Marks]***

(iv) List the tests that are specified for (a) thermal cracking, (b) rutting and (c) fatigue of mixes in the performance grading of asphalt. ***[3 Marks]***

(v) Why is it necessary to degas the sample in long-term ageing simulation test? ***[2 Marks]***

(vi) What do you mean by target viscosity of crumb rubber modified bitumen? ***[3 Marks]***

Q4. A specimen of bituminous mix has a height of 6.35 cm and a diameter of 10.16 cm. The weight of compacted specimen (uncoated) in air is 1240.1 g and in ***[11 Marks]***

water is 675.2 g. When coated with paraffin, its weight in air increases by 34.1 g and decreases by 4.1 g in water. Specific gravity of paraffin is 0.90. Use the data below:

Table 1: Data for Q.4

Material	**Specific gravity**	**% by wt. of total mix**	**% by wt. of total aggregates**
Bitumen	1.01	5.5	
Coarse agg.	2.61	54.0	56.0
Fine agg.	2.65	34.0	36.6
Mineral filler	2.68	6.5	7.4

Determine:

(i) Bulk density of uncoated specimen found through immersion test.

(ii) Bulk density of specimen coated with paraffin found through immersion test.

(iii) Maximum theoretical density of specimen.

(iv) Percent voids in compacted mix.

(v) Percent voids in mineral aggregates.

(vi) If the aggregates are capable of absorbing bitumen, then calculate the absorbed and effective bitumen content.

Q5. Marshall stability tests were conducted on five specimens, each of 101.6 mm diameter and 63.5 mm height. The test results are given in Table 2. (Present the required plots in one graph paper, and rite your name & BITS ID on the graph sheet). ***[9 Marks]***

(i) Find the optimum binder content of the mix. Use a single graph sheet for plotting.

(ii) Find the Marshall Quotient for the mix with the binder content equal to the optimum binder content.

Table 2 : Marshall stability test results

Bitumen content (%)	**Stability (kgf)**	**Flow (mm)**	**Air voids (%)**	**VFB**	**G_m or G_{av} or G_{mb}**
3	500	9	12.5	35	2.10
4	750	9.5	7.5	65	2.20
5	800	12	3.5	85	2.25
6	750	15	2.5	90	2.20
7	650	19.5	2.0	95	2.15

Q6. Describe in detail the steps to be followed during balanced area method while blending 3 different materials. Assume necessary data. ***[5 Marks]***

Q7. True / False. If false, correct the false statement technically. Marks shall not be awarded if the correction is carried out by merely writing the opposite statement.

Eg: Q: The unit of length is seconds.

Answer : False, The unit of length is not seconds (NO MARKS)

False, the unit of length is metre as per SI units (technical correction)

(i) Kinematic viscosity of bituminous binders measures the resistance to flow under shear. ***[1 Mark]***

(ii) Bitumen A and bitumen B have 6 mm and 10 mm as penetration values, respectively. So, in general, softening point of A is greater than softening point of B. ***[1 Mark]***

FORMULA SHEET

Terms have the standard definition

GI=0.2a+0.005ac+0.01bd	$\Delta = 1.18\frac{pa}{E}$	
$T_{pav} = 1.56 + 0.72T_{air} - 0.004Lat^2 + 6.26\log_{10}(H+25) - Z\sqrt{(4.4 + 0.52\sigma_{air}^2)}$		
$T_{20mm} = (T_{air} - 0.00618Lat^2 + 0.2289Lat + 42.2)(0.9545) - 17.78$		
VTM or (% air voids) = $\frac{G_t - G_m}{G_t}$ x 100	VMA = [VTM + ($\frac{W_B}{G_B} \times \frac{G_m}{W}$)] x 100	VFB = $\frac{(VMA - VTM)}{VMA}$ x 100
$G_{se} = [\frac{1 - P_b}{(\frac{1}{G_{mm}} - \frac{P_b}{G_b})}]$	$P_{ba} = G_b\left(\frac{G_{se} - G_{sb}}{G_{se} \times G_{sb}}\right) \times 100$	